Registered at the G.P.O. for Transmission to Canada and Newfoundland by Magazine Post.

VOL. 29. Ser. A. Part 4. pp. 153–224. APRIL, 1941.

THE REVIEW OF APPLIED ENTOMOLOGY.

SERIES A: AGRICULTURAL.

ISSUED BY THE IMPERIAL INSTITUTE OF ENTOMOLOGY.

LONDON:
THE IMPERIAL INSTITUTE OF ENTOMOLOGY,
41, QUEEN'S GATE, S.W.7.

Price 3s. net.

All Rights Reserved.

IMPERIAL INSTITUTE OF ENTOMOLOGY.

Executive Council.

Dr. WILLIAM ALLEN, *Chairman*, Canada.
SHAMALDHARI LALL, C.I.E., *Vice-Chairman*, India and Burma.
Sir DONALD FERGUSSON, K.C.B., United Kingdom.
F. L. McDOUGALL, C.M.G., Australia.
F. J. DU TOIT, Union of South Africa.
NEVILL L. WRIGHT, F.I.C., D.I.C., New Zealand.
J. M. ADAMS, F.R.C.Sc.(I), Eire.
D. JAMES DAVIES, C.B.E., Newfoundland.
B. F. WRIGHT, Southern Rhodesia.
J. A. CALDER, C.M.G., Colonies, Protectorates and Mandated Territories.
Sir DAVID CHADWICK, K.C.M.G., C.S.I., C.I.E., *Secretary*.

Director.

Sir GUY A. K. MARSHALL, C.M.G., F.R.S.

Assistant Director and Editor.

Dr. S. A. NEAVE, O.B.E.

Assistant Director.

Dr. W. R. THOMPSON, F.R.S.

Head Office—British Museum (Natural History), Cromwell Road, London, S.W.7.

Publication Office—41, Queen's Gate, London, S.W.7.

IMPERIAL INSTITUTE OF ENTOMOLOGY

FARNHAM HOUSE LABORATORY

The war has reduced the opportunities for work based on Farnham House. Dr. Thompson, the Superintendent of the Laboratory, is now stationed at the Dominion Parasite Laboratory, Belleville, Ontario, Canada, where the Canadian Government has provided quarters and facilities for his work and that of his staff on the biological control of insect and plant pests. His senior assistant, Mr. E. Cameron, remains in the United Kingdom available for such work as can be done in that country.

Work on the natural enemies of animal and plant pests can now be undertaken in the temperate, subtropical and tropical regions of the Western Hemisphere. Entomologists in the countries of the British Commonwealth of Nations who wish to avail themselves of this opportunity for an extension of their biological control work are asked to communicate with Dr. W. R. Thompson, F.R.S., Imperial Parasite Service, Imperial Institute of Entomology, 228, Dundas Street, Belleville, Ontario, Canada, giving a detailed statement of their requirements.

Those who require parasites normally obtainable in the United Kingdom are asked to send their requests with similar details to The Director, Imperial Institute of Entomology, British Museum (Natural History), Cromwell Road, London, S.W.7, England.

Such division of orders should save time, but the parasites required will be obtained from whichever source is the more convenient or more promising. Dr. Thompson remains as Superintendent and in general charge.

ENTOMOLOGICAL LITERATURE

LARGEST STOCK IN THE WORLD

of Books, Serials and Pamphlets, in all Languages, relating to INSECTS, SPIDERS, MITES and TICKS.

CATALOGUES ON APPLICATION

Liberal allowances in cash or exchange will be made for authors' reprints, and other works of entomological interest.

JOHN D. SHERMAN, JR.,

132 PRIMROSE AVENUE, MOUNT VERNON, NEW YORK

ZOOLOGICAL RECORD — PART INSECTA.

The "Insecta" part of the "Zoological Record" is published annually about July at 15/6 post free.

It contains as complete a record as possible of the entomological literature of the previous year and comprises three main sections :—

1. Titles of papers, over 3,000 in number, arranged under authors ;
2. an Index dealing with such subjects as Morphology, Physiology, Ecology, etc. ;
3. a Systematic portion, which occupies about half the whole. This constitutes a classified index of all the new genera and species of insects that have been published during the year, as well as references to general papers on systematics.

Orders should be addressed to *The Assistant Director, Imperial Institute of Entomology*, 41, *Queen's Gate, London, S.W.*7.

Orders for the *complete* volume of the "Zoological Record" (as opposed to the "Insecta" part) should be sent to the Zoological Society of London, Regent's Park, London, N.W.8.

PYRETHRUM AND DERRIS PREPARATIONS

Stafford Allen & Sons, Ltd., have undertaken original research on Pyrethrum and Derris, and are in a position to supply biologically tested liquid extracts, powders, agricultural insecticides, etc.

ENQUIRIES INVITED.

STAFFORD ALLEN & SONS, LTD.,

Manufacturing Chemists. *Established 1833.*

20–42, WHARF ROAD, CITY ROAD, LONDON, N.1

CHIAO (C. Y.) & PEN (D. S.). **China Wax or Insect Wax Industry of Szechuan.**—*China J.* **32** no. 3 pp. 107–113, 3 figs. Shanghai, 1940. (Abstr. in *Lingnan Sci. J.* **19** no. 4 p. 615. Canton, 1940.)

China wax is secreted by the Coccid, *Ericerus pela*, Chav., of which the usual food-plants are *Ligustrum lucidum* and *Fraxinus chinensis*. About 2,800 tons of this wax are produced annually in Szechuan. The eggs, which are wrapped in waxed paper and transported through the Province by dealers, hatch in May or June, and the crawlers are active for about two weeks before settling permanently on the branches. The adults mature in autumn and overwinter. The wax is secreted by the male and is generally harvested by chopping off the branches and collecting the wax fragments by hand in autumn before the adult males emerge. Wax obtained by crushing the insects or boiling the branches is inferior.

CHAN (Konyil). **Notes on Vegetable Insect Pests in Hong Kong. Part II.**—*Hong Kong Nat.* **10** no. 2 pp. 98–101, 7 figs. Hong Kong, 1940.

In this second note [*cf. R.A.E.*, A **28** 156], descriptions are given of all stages of *Plutella maculipennis*, Curt., the larvae of which cause considerable damage to cruciferous crops in Hong Kong. The egg, larval and pupal stages lasted 3–5, 12–17 and 4–7 days in the laboratory. The moths remain quiescent during the day, normally among the leaves of the food-plants. They are inactive in the winter, and hibernation probably occurs in the adult stage.

SMEE (C.). **Report of the Entomologist 1939.**—11 pp. typescript. [Zomba] Dep. Agric. Nyasaland [1940].

Towards the end of 1939, 18 larvae of *Platyedra gossypiella*, Saund. [*cf. R.A.E.*, A **27** 126] were discovered in cotton bolls in the Lower Shire district of the Nyasaland Protectorate, and a single example of the Braconid, *Chelonus* (*Chelonella*) *ritchiei*, Wlkn., was bred from them. No larvae of *Platyedra* had been found earlier in the year when large numbers of bolls from this district were examined, but it appears from information received later, that it may have been more widely spread in the neighbouring territory for some years past than was generally realised and that the cultural methods practised in the Zambesi and Shire valleys would have permitted easy survival and dispersion. It is considered that control would be possible if a strict dead season were enforced between successive crops on both sides of the international boundary. A mislaid record was found of the rearing of two examples of the Tachinid, *Thelaira nigripes*, F., from larvae of *Diparopsis castanea*, Hmps., on cotton in this district in 1932, but this parasite is apparently of little economic importance.

All types of tobacco on two experiment stations were affected by an unusual form of virus disease, the symptoms of which are described. Material was submitted to K. M. Smith, who reported that two viruses were present, *viz.*, the normal tobacco rosette, and a mottle-producing

(508) Wt. P14/3703 1700 5/41 S.E.R. Ltd. **Gp. 432.** [A]

virus, both of which are transmissible by *Myzus persicae*, Sulz. This Aphid was found on the weeds, *Cleome monophylla* and *Gynandropsis pentaphylla*, in February and April, respectively. Infestation of coffee by the Lamiid, *Anthores leuconotus*, Pasc., was not reduced by any particular type of cultivation, but records of the yield of coffee from different plots over three years emphasised the value of shade and heavy mulch with forest foliage under local conditions. The Limacodid, *Niphadolepis alianta*, Karsch, continued to be a serious pest of tea in the Cholo district [*cf.* **28** 306 ; **29** 59, 60]. Parasites reared during the year [*cf.* **28** 306] comprised *Euplectrus* spp. (possibly two species) and *Rhogas* sp. from the early-instar larvae, a Tachinid from a late-instar larva, and a species of *Chrysis* (*Pentachrysis*) and two Ichneumonids from the cocoons, but only *Euplectrus* and *Chrysis* were at all numerous. The total percentage parasitism of larvae and cocoons was only about 7 [*cf.* **29** 61], but the percentage of larval mortality due to " wilt " disease [*cf. loc. cit.*] reached about 60 by July among individuals that had not spun cocoons. Other pests of tea were *Pseudococcus perniciosus*, Newst. & Willc., which showed signs of spreading on one estate, adults of a Melolonthid of the genus *Trochalus*, which probably migrated from *Eucalyptus*, and leaf-eating caterpillars, which, in addition to those already noticed [**29** 60], included the Limacodids, *Parasa latistriga*, Wlk., and *Omocena convergens*, Hering, which were rare.

Maize in one district was attacked by *Busseola fusca*, Fuller, and a Galerucid beetle, which was destructive to the silk. Certain strains of *Pennisetum* at an experiment station were attacked by *Laphygma exempta*, Wlk., which was, however, effectively controlled by liberally dusting the plants with pyrethrum powder. An outbreak of *Cylas puncticollis*, Boh. (*compressus*, Hartm.) on sweet potatoes occurred in gardens in one district, and *Gnorimoschema* (*Phthorimaea*) *operculella*, Zell., was abundant on English potatoes in another. *Phaseolus* beans planted in March in a highland district were in some cases completely destroyed by a species of *Agromyza* (*Melanagromyza*).

Oviposition by *Nomadacris septemfasciata*, Serv., which was again the only locust reported in the Protectorate, continued into early January 1939 [*cf.* **28** 305], and by February bands of hoppers were present in the southern part of it. Poison spraying was carried out in some districts in January–March with considerable success, and by the end of March *Empusa grylli* was prevalent. The first flying swarm appeared on 12th March, but swarms were not numerous on the whole, as a result of the destruction of hoppers by various agencies. Several large swarms were observed in October, however, and further ones entered from the south and east in November, when some migrated northwards. Oviposition began in the second half of November. The northerly trend continued during December, and districts that had been free of locusts for some years were entered. Egg-laying occurred in many districts in December, and hoppers hatched in Lower Shire. It was anticipated that a heavy outbreak would occur in the 1939–40 season, but in the majority of cases the hoppers were in small " pockets," which were more easily destroyed by beating than spraying. There seemed to be little egg-laying by any of the swarms that reached the Northern Province, and the loss incurred was slight as most crop plants were in an advanced stage when the hoppers appeared. The periods over which egg-laying has taken place in Nyasaland in each year since the present invasion began in 1932 are shown in a table.

Quilis Pérez (M.). **Cálculo de las fajas isocondicionales y de las líneas de máximo desarrollo para los insectos.** [The Calculation of the Zones of Equal Conditions and of the Lines of Maximum Development for Insects.]—*VI Congr. int. Ent. Madrid 1935* **2** pp. 447–454, 4 figs., 7 refs. Madrid, 1940.

The respective importance of biological control and ecological factors in limiting the abundance of an insect cannot be evaluated without a minute and complete study of the factors involved. Taking *Pseudococcus citri*, Risso, as an example, the author records the localities in various parts of the world in which this mealybug has been found. They all occur between latitudes 11°S. and 50°N. and are most concentrated around 40°N. and between longitudes 20°E. and 10°W. The range of the mealybug is limited by the annual isotherm of 8·5°C. [47·3°F.], and the most infested areas are those with a dry, temperate, semi-maritime climate, including the whole of the region surrounding the Mediterranean. Its development is retarded by high humidity, as has been shown in the insectary at Valencia, where its life-cycle lasted 29 days at an average temperature of 22·2°C. [71·96°F.] and an average relative humidity of 66·6 per cent., and 35 days at 23·1°C. [73·58°F.] and 87·7 per cent. As regards altitude, it does not occur above 250 ft. [but *cf. R.A.E.*, A **27** 161]. *Citrus* is its preferred food-plant, but it infests coffee in Java [*loc. cit.*] and wild olive (*Olea chrysophylla*) in Eritrea [**20** 103]. A comparison of data on temperature, humidity, altitude, preferred food-plants, longitude and latitude makes it possible to state whether *P. citri* can survive in a given locality. By joining up all such localities, it is possible to establish the zone of equal conditions, which can be shown on a map. The localities where all the conditions are favourable may be joined by a line, which the author calls the line of maximum development and which passes through all points with an average temperature of 20–30°C. [68–86°F.] and an average humidity of 65–70 per cent. from June to October, an altitude not exceeding 165 ft., and an abundance of attractive food-plants, a list of which is given.

Malenotti (E.). **Pesco e pero di fronte alla lotta invernale contro la *Diaspis leperii* Sign. (Variabilità di resistenza agli insetticidi dovuta alla pianta-ospite.)** [Peach and Pear as regards Winter Measures against *Epidiaspis leperii*. (Variation in the Resistance of this Coccid to Insecticides due to the Food-plant.)]—*VI Congr. int. Ent. Madrid 1935* **2** pp. 611–619. Madrid, 1940.

The author explains and illustrates the mathematical formula by which he estimated the percentage mortality of *Epidiaspis* (*Diaspis*) *leperii*, Sign., on peach in the district of Verona caused by insecticides in the winter of 1933–34 [*cf. R.A.E.*, A **22** 492] and gives figures showing that in that and the following winter the percentage mortality caused by a mineral oil (winter Volck) and two tar distillates (Neodendrin and Fitodendrin) was greater on peach than on pear. Possible reasons for this difference are discussed ; it may be due to a greater resistance of the Coccid on pear, which is its preferred and possibly its original food-plant, or to the bark of pear being less easily penetrated by sprays. It is concluded that the concentration of 5 per cent. recommended when using tar distillates against *E. leperii* on peach should be increased to 7 per cent. when the food-plant is pear.

QUILIS PÉREZ (M.). **Influencia de los factores climáticos en el cálculo de los ciclos biológicos de los insectos.** [The Influence of Climatic Factors in the Calculation of the Biological Cycles of Insects.]—*VI Congr. int. Ent. Madrid 1935* **2** pp. 622–633, 11 refs. Madrid, 1940.

The author discusses the effect on the life-cycle of insects of temperature, humidity and other ecological factors, such as light, and gives mathematical formulae designed to enable the complete developmental cycle to be ascertained before it is actually completed, provided that field and laboratory observations have supplied the requisite basic data.

NAUDÉ (T. J.). **On the Use of Aeroplanes in combating invading Swarms of the Red Locust with Arsenical Dust.**—*VI Congr. int. Ent. Madrid 1935* **2** pp. 781–796, 1 pl. Madrid, 1940.

Following preliminary trials on the use of an aeroplane for dusting resting bands and swarms of *Nomadacris septemfasciata*, Serv., in the Union of South Africa in the early part of 1934 [*cf. R.A.E.*, A **22** 706; **24** 395], a series of experiments was made during the pre-breeding migration of this species in August-December 1934 in northern Zululand, which was being invaded by swarms flying southwards from Mozambique. Dusting was directed against settled swarms of sexually immature adults, which fly and roost on trees and bushes in a compact formation. Hercules three-engined aeroplanes, fitted with duraluminium dust boxes and carrying a load of 2,070 lb. sodium arsenite dust were used. Flying at about 80 miles per hour and releasing 6 lb. dust per second about 60 ft. above the ground produced a swath 440 yards wide. In a still atmosphere, the dust cloud emitted at a height of 60–100 ft. sank to the ground in 10–15 minutes; in a gentle wind it disappeared into the bush in a leeward direction in 5 minutes. These results were independent of absolute altitude, and it appears therefore, that it would not be practicable to use arsenite dust against swarms in flight. The toxicity of the cloud was greater on the windward than on the leeward side, but in earlier experiments it was found that dusting in a strong wind at the rate of 5 lb. per second resulted in definite mortality of fifth and sixth-instar hoppers at 250 yards to the leeward of the line of flight.

During the field operations, light scouting aircraft were sent out during the last 2–3 hours in the afternoon to map the position of swarms, which were then dusted from the heavy aeroplanes between 5 and 8 a.m. on the following morning. In the afternoon and early morning, settled swarms could be seen from a distance of 15 miles, the best visibility being obtained from a position between the swarms and the sun; flying swarms could be seen from a distance of 30 miles.

The practical success achieved by dusting from the air was considerable, for the force of the invasion was definitely diminished, in spite of almost daily influxes of fresh swarms from over the border. As the complete destruction of swarms would have necessitated dangerously heavy dosages, the method adopted was to apply a light cover to the whole swarm, by making use of atmospheric movements. Scores of swarms were so treated, and the results were almost invariably a high mortality that reached a peak in about 48 hours, enfeebled activity of the swarm and the widespread occurrence of

scattered poisoned locusts. Attenuated straggling swarms, suffering from delayed arsenical poisoning, were seen for distances of up to 150 miles from the scene of operations. Poisoning was most successful in a high atmospheric humidity, for on misty mornings or over swampy ground striking mortality was observed within half a day. The success was also dependent on the treatment of swarms before the locusts reached complete sexual maturity, for immediately before oviposition the swarms lose their compactness and scatter, and are moreover less easily seen owing to their lighter coloration. Another limiting factor towards late November was the high temperature, owing to which swarms were often on wing as early as 6.30 a.m., and sometimes flew till after dark.

The results of the trials indicate that a scheme of " border protection " based on the dusting of settled swarms from the air would be practicable in a country such as the Union of South Africa, where the value of land near the northern border is small in comparison with that of the pastoral and agricultural land further south. It would be desirable to clear the border zone of stock for the period of operations. The confining of poisoning activities, however intensive, to this zone would not only protect the rest of the country from the ravages of invading swarms and their progeny, but also safeguard it from the danger of poisoning involved in a widespread campaign against hoppers. The cost of maintaining two Hercules and two scouting planes for four months was £2,000, which compares favourably with the expenses involved in an anti-hopper campaign, which in one magisterial district of Natal cost £40,000 for one month. Complete operations would require about six multi-engined easily manoeuvrable dusting planes of several tons capacity and able to work over level and broken ground, and several scouting planes for carrying out daily patrols along the border and occasional long-range reconnaissances in the direction of the source of invasion.

HIBRAOUI (H.). **La lutte contre les ennemis des cultures depuis mil ans en Andalousie et en Arabie.**—*VI Congr. int. Ent. Madrid 1935* **2** pp. 803–810, 24 refs. Madrid, 1940.

The author reviews references in Moorish and Arab literature dating from about the ninth to the sixteenth century to insects of economic importance and methods of controlling them.

WOLCOTT (G. N.). **A List of Woods arranged according to their Resistance to the Attack of the " Polilla," the Dry-Wood Termite of the West Indies,** *Cryptotermes brevis* **Walker.**—*Caribb. Forester* **1** no. 4 pp. 1–10, 2 figs. Rio Piedras, P.R., 1940. (With a Summary in Spanish.)

Tests, carried out in Porto Rico in 1936–39, of the resistance of various timbers to *Calotermes* (*Cryptotermes*) *brevis*, Wlk., the dry-wood termite of the West Indies, and the characters of the principal timbers tested are briefly described ; and a list of the timbers, arranged in order of resistance, is given and compared with one based on previous work [*cf. R.A.E.*, A **13** 196]. It is pointed out that the termite in question, which is found throughout the tropical Americas, occurs only

in the southern tip of Florida in the United States. The data given are not reliable, therefore, for termite control in the United States, but may be of value to manufacturers of furniture to be sold in the tropics.

Reid jr. (W. J.). **Biology of the Seed-corn Maggot in the Coastal Plain of the South Atlantic States.**—*Tech. Bull. U.S. Dep. Agric.* no. 723, 43 pp., 7 figs., 32 refs. Washington, D.C., 1940.

The following is taken from the author's summary of studies of the biology of *Hylemyia cilicrura*, Rond., in the eastern portions of North Carolina and South Carolina, conducted during 1925–35 in connection with attempts to devise a means of preventing the damage it causes to spinach seedlings [*R.A.E.*, A **25** 181] and to potato seed pieces [**28** 579].

Eggs are deposited in the soil, on or near a source of larval food. The mean incubation period ranges from 1 to 8·5 days, at mean temperatures ranging from 83·7 to 42·5°F., respectively. Eggs hatch at mean temperatures as low as 40–45°, and as high as 95°. None hatched at a mean temperature of 100°. The larvae feed in the soil upon a variety of both living and dead plant and animal matter. Partly decayed vegetation and the sprouting seed and seedlings of such crops as beans, peas, and spinach are favourite foods. Organic fertiliser materials also serve as larval food. Potato seed pieces are attacked only when decaying or poorly healed. The duration of the larval stage ranges from 5 to 78 days at mean temperatures of from 100 to 40–45°F., and from 7 to 26 days during the period that seed potatoes are attacked in the coastal areas of the southern Atlantic States. Larval development is greatly retarded at temperatures below 50°. Comparatively few larvae survived when caged in the open field from May to October, or at constant temperatures of 95° or above. The prepupal period lasts about 2 days during the spring. Pupation takes place in the soil, usually near the place of larval feeding, and at an average depth of $2\frac{1}{4}$ inches in a moist sandy loam. The pupal stage lasts from 7 to 26 days at mean soil temperatures of 83·7° to 54·1°F., from 7 to 18 days during the spring, and as long as 126 days at 40–45°F. Relatively few pupae survive constant temperatures above 90°.

Adults emerge from the soil only during the night or early morning, and can reach the surface from depths as great as 7 ins. in a sandy loam soil. They feed upon the flowers of a number of cultivated and wild plants. The organic fertiliser materials, fish meal, cottonseed meal, animal tankage, and dried blood proved most effective as baits in trapping them. Bait-trap records indicated that they are most abundant, during the year as a whole, in freshly cultivated fallow areas and that they seek protection in areas under vegetation during the summer. They are most active during mid-day in winter and early spring, and during the late afternoon and early morning at other times of the year. Their activity is restricted at temperatures below 50 and above 90°F., and some activity was noted at temperatures as low as 32°. Wind and rain greatly decrease their activity. They are most abundant during the spring and late autumn, and least abundant in mid-summer.

Mating of caged adults was rare. The average mated female lived for 34·25 days, began to oviposit after 12·5 days, and laid 97·25 eggs. Eggs were deposited in the insectary during all months of the year by adults caught in traps. As the adults rarely mated in confinement,

records concerning the entire life-cycle and number of generations are limited. However, the indications were that the period from oviposition to oviposition might range from means of 20·4 to 176·1 days, at ranges of mean temperatures from 75·2–100 to 40–56·6°F., respectively. The total length of life (from egg deposition to death) might range from 39 to 250 days for males, and from 44 to 255 days for females, both at mean temperature ranges of 100–40°F., respectively. Rearings of groups of individuals under approximately normal conditions at various seasons of the year showed a range of 14 to 88 days, at mean soil temperatures of from 81·4 to 45·3°F., respectively, for the period from hatching to adult emergence. The same period during the time that potato seed pieces are attacked ranged from 23 to 37 days, at mean soil temperatures of 62·3°F. There were indications of three possible generations during the active breeding season.

The immature stages were seen in the field from late in September until the end of April. Peaks of population occurred during October and November, and from the latter part of February through March and April. Only adults, chiefly females, were found during the summer, but there was evidence of restricted breeding in cool, moist situations during that period. No pupal diapause was noted, but it is possible that some pupae aestivate, as they are stated to do so in Transcaucasia.

Although this Anthomyiid was found to have several parasitic and predatory natural enemies, they did not appear to play an important part in reducing its abundance.

Moznette (G. F.), Nickels (C. B.), Pierce (W. C.), Bissell (T. L.), Demaree (J. B.), Cole (J. R.), Parson (H. E.) & Large (J. R.). **Insects and Diseases of the Pecan and their Control.**—*Fmrs' Bull. U.S. Dep. Agric.* no. 1829, 70 pp., 64 figs., 2 refs. Washington, D.C., 1940.

This revision of a previous bulletin [*R.A.E.*, A **19** 267] on the insects and diseases that attack pecan has been rendered necessary in view of the increased cultivation and economic importance of this crop in the southern United States. Infestation by insect pests has been favoured by the tendency to grow pecan in extensive areas under orchard conditions. The bulletin is intended to furnish growers with information that will enable them to recognise the insects and diseases and to employ effective control measures against them. It includes brief accounts of the bionomics and control of more than twenty insect pests, of which the most important are the pecan nut casebearer, *Acrobasis caryae*, Grote, the hickory shuckworm, *Enarmonia* (*Laspeyresia*) *caryana*, Fitch, and the black pecan Aphid, *Melanocallis caryaefoliae*, Davis. A final section contains directions for the preparation and application of various sprays and a programme of combined sprays to be applied against both fungi and insects.

Snapp (O. I.). **The Peach Borer—How to prevent or lessen its Ravages.** —*Fmrs' Bull. U.S. Dep. Agric.* no. 1246, 13 pp., 10 figs. Washington, D.C., 1940.

This revision of a previous bulletin [*cf. R.A.E.*, A **21** 44] on the bionomics and control of *Aegeria* (*Conopia*) *exitiosa*, Say, on peach

in the United States contains an additional section on the use against it of ethylene dichloride emulsion [*cf.* **27** 255 ; **28** 356], which has the advantage of being comparatively safe on young trees when applied at the proper strength, can be used in colder weather than paradichlorobenzene and can be applied with greater ease. A table is given showing the correct amounts to be used for trees of various ages.

VINSON (C. G.) & MCCRORY (S. A.). **Substitute Spray Materials II.**—*Res. Bull. Missouri agric. Exp. Sta.* no. 316, 14 pp. Columbia, Mo., 1940.

Details are given of experiments in Missouri in 1939, the main results of which have already been noticed [*cf. R.A.E.*, A **29** 45], showing the effectiveness against larvae of *Cydia pomonella*, L., on apple of a spray of nicotine sulphate and bentonite, in which the materials are mixed dry [**27** 133], so that the resulting spray leaves no evident deposit on the fruit. The addition of summer oil, whole milk powder, or Vatsol O.T. increased the effectiveness of the spray, but the addition of Floor Seal (a type of varnish that quickly dries to a very hard surface) did not, although it increased the deposit and retention of nicotine on the fruit and foliage.

TUCKER (R. W. E.). **An Account of** *Diatraea saccharalis* **F. with special Reference to its Occurrence in Barbados.**—*Trop. Agriculture* **17** no. 7 pp. 133–138, 25 refs. Trinidad, 1940.

The distribution of *Diatraea saccharalis*, F., which is the most important pest of sugar-cane in the western hemisphere, is recorded, and data on its ecology, habits and natural enemies in Barbados and elsewhere are discussed. It is concluded that its prevalence and biological control depend on factors, chiefly ecological, that vary according to country and limit the numbers of its parasites. Of these, the Tachinids are principally affected by wind velocity and the presence of alternative food-plants and shelter, and the egg parasites by the temperature and humidity inside the cane canopy. Ecological conditions in Barbados explain the absence of most of the parasites of *Diatraea* and the failure to establish larval parasites that have been introduced in large numbers and breed freely in the laboratory. *Trichogramma minutum*, Riley, appears to be the only effective native parasite in the Island. Experience there over 12 years has shown that large-scale liberations of *Trichogramma* result in an economic reduction in the loss caused by the borer [*cf. R.A.E.*, A **23** 420 ; **28** 413]. Some explanation of the fact that similar work in Louisiana was effective in 1931–34 and has not been so since is given by Dugas [**28** 241], and the author also considers that the value of the parasite in its natural occurrence, or aided by mass colonisations, is subject to fluctuations, mainly due to climatic variations. Laboratory and field observations indicate that its maximum effectiveness is secured only within a comparatively narrow range of temperature and humidity, which is probably about 90°F. and just under 100 per cent. relative humidity, though its survival capacity extends over a wide range of temperature and humidity. Adverse climatic conditions that reduce its effectiveness are often overlooked.

Pepper (J. H.). **The Effect of certain Climatic Factors on the Distribution of the Beet Webworm** (*Loxostege sticticalis* **L.**) **in North America.**—*Ecology* **19** no. 4 pp. 565–571, 1 map, 5 graphs, 7 refs. Brooklyn, N.Y., 1938. [Recd. 1941.]

Since 1900, when it was first grown on a commercial scale in the United States, sugar-beet has been periodically attacked by *Loxostege sticticalis*, L. The normal range of this Pyralid includes western, north-central and north-eastern Europe, north-western Asia and the Great Plains and Rocky Mountain regions of North America. Its food-plants are so varied that they can have little if any influence in limiting its distribution, which is probably governed by climatic factors. A map of the United States and Canada is given showing that the southern limit of its range extends to the annual isotherm of 55°F., and the eastern and western limits to the annual isohyets of 25 and 10–15 ins., respectively. It is concluded that, except for occasional outbreaks due to climatic fluctuations in areas bordering the infested region, it is unlikely that *L. sticticalis* will ever be a pest outside these limits.

Friend (R. B.). **Connecticut State Entomologist, Thirty-ninth Report, 1939.**—*Bull. Conn. agric. Exp. Sta.* no. 434 pp. 222–322, 7 figs., many refs. New Haven, Conn., 1940.

An annotated list is given by R. B. Friend (pp. 223–225) of insect pests observed in Connecticut in 1939, and J. T. Ashworth and O. B. Cooke (pp. 239–247) report on work in connection with the control of *Lymantria* (*Porthetria*) *dispar*, L., in 75 localities during the year ending 30th June 1939. J. P. Johnson (pp. 248–250) briefly reviews work against *Popillia japonica*, Newm., which spread to 7 fresh towns and has now been recorded from 80 towns in the State. Dry weather in late June and July delayed the emergence of the adults from the soil; the first was observed on 22nd June, and they continued to appear until early August. A general increase in population occurred in all infested areas, and the larvae damaged or destroyed over 2,000 acres of turf in lawns, parks, etc.

P. Garman, J. C. Schread, W. T. Brigham and G. R. Smith (pp. 258–260) give an account of work on biological control [*cf. R.A.E.*, A **28** 642, 643]. Evidence was obtained confirming the establishment of *Tiphia popilliavora*, Rohw., as a parasite of *P. japonica* and further colonies of *T. vernalis*, Rohw., were liberated. No systematic scouting for the latter was carried out, but it appears that parasitism by it is increasing rapidly. Of the parasites released against *Cydia* (*Grapholitha*) *molesta*, Busck, on peach, *Microdus* (*Bassus*) *diversus*, Mues., has survived for 3 years in some orchards, *Angitia* (*Dioctes*) *molestae*, Uch., was recovered but apparently does not survive in Connecticut for more than a year, while *Orgilus longiceps*, Mues., was recovered in one orchard, for the first time.

Experiments on the control of *Rhagoletis pomonella*, Walsh, on apple by means of oil-impregnated rotenone dusts are described by Garman & J. F. Townsend (pp. 264–269). They showed that high temperatures (100–105°F.) and high humidity for 3–5 days had very little effect in reducing the rate of mortality in the laboratory, but that exposure to strong sunlight destroyed the active principles of the dust in a few days. A dust containing 4 per cent. white lubricating oil and enough derris

to give 0·5 per cent. rotenone with aluminium silicate as the carrier retained its effectiveness for 3 hours in bright sunlight in midsummer and for 5½ during an overcast period or under shaded conditions. When applied with a power duster to apple trees in an orchard, it rapidly destroyed the flies at first, but they reappeared in 4–5 days. It was applied, at the rate of 1–2 lb. per tree, on 3rd, 11th and 21st July and 2nd August on trees that had been sprayed with lead arsenate on 8th and 23rd May and 2nd June, and the control obtained was about equal to that in neighbouring orchards heavily sprayed with lead arsenate.

In an account of the work with adhesives for sprays (pp. 269–272) Garman and C. E. Shepard state that apple trees sprayed with lead arsenate and aluminium acetate retained practically all their foliage throughout the season and adhesion was good. In comparative experiments, aluminium sulphate was as effective with lead arsenate as a number of non-mineral oils and caused less scorching of the foliage in hot weather. Of oils used in combination with sulphur on beans under glass, *Perilla* oil, which dries rapidly, caused less injury than most others.

Investigations on the use of manganese sulphate as a safener for sprays containing lime-sulphur and lead arsenate are briefly recorded by Garman (pp. 272–273). When used at rates of 4–6 oz. per 100 U.S. gals., it is an effective safener, but greatly reduces the fungicidal action of the lime-sulphur. Satisfactory results were obtained on two varieties of apple with only 2 and 1 oz. manganese sulphate per 100 U.S. gals. when 2 and 1 U.S. gals. lime-sulphur were used. These sprays should apparently be applied heavily both inside and outside the tree.

N. Turner (pp. 273–275) discusses investigations on the possibility of modifying the standard dusting programme against *Pyrausta nubilalis*, Hb., on maize, which consists of applications at intervals of five days. The dust used was a commercial dual-fixed nicotine [*cf.* **25** 770] applied by means of hand dusters. The standard treatment involved four applications against the first generation and five against the second and reduced the numbers of larvae by 62·4 and 58·5 per cent., respectively. Reduction of the number of applications by increasing the intervals between them or omitting one or more from the standard gave inferior control, but reducing the number of treatments by one and applying them at seven-day intervals was almost as effective, reducing the numbers of larvae by 61·5 and 56·7 per cent. Quebracho tannin was as effective as gallo-tannin in a dual-fixed nicotine dust [*cf.* **28** 174], and hand dusting gave better control than machine application. Small-scale field experiments recorded by R. L. Beard (pp. 275–276) showed that infestation of early or late potatoes by *P. nubilalis* has no appreciable effect on the crop yield.

Data are given by Turner (pp. 277–283) on the bionomics and control of *Epitrix cucumeris*, Harr., obtained during 1931–37. They indicate that it has only one complete generation a year in Connecticut [*cf.* **21** 511]. It has not only been a serious pest of potatoes for many years, but also damages newly set tomatos and egg-plants [*Solanum melongena*] and has been seen in injurious numbers on cucumbers and beans. Newly set plants and seedlings have been fairly well protected from the beetles by dusting 3 times at weekly intervals, beginning in the first week of June, with a mixture of 1 lb. barium fluosilicate and 3 lb. lime, or with a cubé dust containing 0·75 per cent. rotenone. The best control on early potatoes was given by the barium-fluosilicate

dust and a spray of 1½ lb. lead arsenate and 1 U.S. pint fish-oil in 50 U.S. gals. water. Potatoes sprayed with the latter matured much earlier than those sprayed with the standard Bordeaux mixture, while the yields were about equal. In the case of late potatoes, neither of these treatments alone was as effective as Bordeaux mixture, since they did not control leafhoppers [*Empoasca fabae*, Harr.]. A combination of dusting with barium fluosilicate and spraying with Bordeaux mixture appeared promising, but the results as regards yield were inconclusive. The addition of calcium arsenate to Bordeaux mixture was of no value.

In a brief account of work on insects attacking squash (pp. 285–287), Beard states that whereas *Diabrotica melanocephala*, F. (*vittata*, F.) is controlled by a derris dust containing 0·6 per cent. rotenone [*cf.* **26** 17], insecticides effective against *Melittia satyriniformis*, Hb., and *Anasa tristis*, DeG., are either too expensive or unsafe to use on summer squash. The heaviest attack by both pests occurs before mid-July and is directed against the larger plants. Tests in 1939 showed that economic loss can be avoided by planting two crops in sequence, so that the first serves as a trap and is destroyed when the second comes into bearing. Thus, summer squash planted on 28th June and 5th July escaped infestation and continued to produce fruit of good quality, whereas the first crop, planted on 8th May was heavily attacked. The yield of Hubbard squash, which is chiefly attacked by *Melittia*, was significantly increased by dusting with dual-fixed nicotine or by spraying with lead arsenate (3 lb. per 100 U.S. gals. water) applied with fish oil or as an inverted spray mixture prepared with oil, oleic acid and triethanolamine [*cf.* **25** 419; **26** 174]. In order to kill the larvae before they entered the stems, 4 applications were made at weekly intervals beginning on 3rd July.

Detailed observations are recorded by P. Wallace (pp. 293–311) on the bionomics of *Scolytus multistriatus*, Marsh., on elm, and all stages are briefly described. The distribution of the Scolytid in Connecticut, where it was first recorded in 1932, is reviewed. It attacks all species of elm grown there, and usually has two complete generations a year, though the second is often partial and there is occasionally only one.

Hibernation takes place exclusively in the larval stage. Some of the young adults feed for a few days on the bark and wood of healthy elms, usually at small twig crotches, near the place of emergence or near that where brood galleries are to be formed, and never at a distance of more than 200 yards from either of these sites. Observations in the field and laboratory indicate, however, that many of the beetles do not feed at all before making their egg galleries. Only one egg gallery is constructed, and the average number of eggs deposited per gallery was 68·5, of which 95·9 per cent. hatched. The larvae are very resistant to extreme conditions of moisture [*cf.* **24** 423]. Those in logs submerged for 2 months in salt water in an ocean inlet were not affected, and when the logs remained submerged for 4 months and enclosed in ice for 3 weeks, about 50 per cent. of the larvae survived and some gave rise to adults in the laboratory. Most larvae removed from their mines died when exposed for a short time to temperatures below −8°F., though some survived at temperatures as low as −70°F. The dispersion of the beetle in Connecticut was little influenced by the hurricane that occurred in September 1938. Extensive laboratory and field tests indicated that infestation of elm logs may be permanently prevented by the application of a light coal-tar creosote oil to the bark, but when applied to logs containing larvae of the beetle, its penetrating

and toxic effects were not entirely satisfactory. Experiments with trap logs showed that the density of the beetle population within an infested area fluctuates rapidly owing to ecological factors and particularly to the availability of breeding material.

Brief notes (pp. 311–318) are given by several authors on miscellaneous pests that occurred during the year, including the ant, *Paratrechina longicornis*, Latr., which caused much loss in an hotel by infesting food ; *Gryllulus* (*Gryllus*) *domesticus*, L., which was abundant in several houses near a rubbish dump and damaged clothes ; *Bryobia praetiosa*, Koch, which often enters houses in large numbers but was successfully controlled by applying fine sulphur dust in hot weather to the lawn for about 15 ft. from a house in which it had been troublesome for several summers ; and *Aserica* (*Autoserica*) *castanea*, Arr., which destroyed the roots of maize seedlings in a field that had been used for pasture or hay. G. H. Plumb and A. De Caprio report serious damage to pure and mixed plantations of white pine [*Pinus strobus*] and red pine [*P. resinosa*] at an experiment station by *Ips pini*, Say, *I. grandicollis*, Eichh., and *I. calligraphus*, Germ. The Tenebrionid, *Hypophloeus parallelus*, Melsh., was also numerous under the bark of the red pines. Red pine in a State forest in south-eastern Connecticut was infested by *I. pini* and also by the weevil, *Pissodes approximatus*, Hopk.

Report of Progress for Year ending June 30, 1939.—*Bull. Maine agric. Exp. Sta.* no. 397 pp. 695–846, 2 col. maps, 9 graphs, 2 figs., many refs. Orono, Me., 1939. [Recd. 1941.]

This report includes notes by various authors on insect pests of crops in Maine in 1938–39. Observations on apple Aphids showed that *Aphis pomi*, DeG., is the most injurious. In 1938, its overwintered eggs began to hatch on 23rd April and 12 generations developed in the course of the season. The first winter eggs were observed on 1st October, and oviposition continued on experimental trees until frost killed the Aphids. The other species commonly found on apple are *Eriosoma lanigerum*, Hsm., *Anuraphis roseus*, Baker, and *Rhopalosiphum prunifoliae*, Fitch, all of which, however, usually occur in small numbers. In 1939, *R. prunifoliae* was very abundant on developing apple buds, and many of the fruit clusters were heavily infested, but it caused no important injury. The gipsy moth [*Lymantria dispar*, L.] was very destructive in many localities in southern and western Maine. The larvae were carried by air currents from infested forests to orchards nearby [*cf. R.A.E.*, A **26** 332], and unsprayed apple trees were generally defoliated by them, but those protected by timely and thorough applications of lead arsenate in the pink, calyx and first cover sprays were only slightly injured.

In view of the fact that they are sometimes confused by maize growers, descriptions are given of the larvae of the corn earworm [*Heliothis armigera*, Hb.], the fall armyworm [*Laphygma frugiperda*, S. & A.], and the European corn borer [*Pyrausta nubilalis*, Hb.], together with notes on their habits, the losses they cause and the usual measures of control.

Macrosiphum onobrychis, Boy. (*Illinoia pisi*, Kalt.), which was abundant in the autumn of 1938, was observed on clover in May 1939 and migrated to peas during June. Its numbers steadily increased until mid-June, when unfavourable weather, together with parasites,

predators and a fungous disease, reduced them, so that on the whole the injury to peas was light. Observations over many years indicate that the increase in acreage under peas in Maine cannot have been responsible for the increase in virus diseases of potatoes, as peas do not harbour Aphids that transmit these diseases, and *M. onobrychis*, which is the common Aphid on peas, does not feed on potato.

Experiments on the control of *Rhagoletis pomonella*, Walsh, on blueberries were continued [*cf.* **28** 174]. The dusts tested, each on ten-acre plots, were calcium arsenate and a mixture of derris and pulverised clay containing 2 per cent. rotenone, and applications were made on 14th and 24th July at the rate of about 6 lb. per acre. Counts at picking time showed that the numbers of larvae per 20 oz. berries averaged 7 for calcium arsenate and 17 for the derris mixture, but plants treated with the latter appeared to retain their foliage more completely. The development of the blueberry thrips, *Frankliniella vaccinii*, Morg., was favoured by cold weather in the spring of 1939. In view of the failure of insecticides to control it [*cf.* **26** 333], tests were made of the effectiveness of picking infested leaf clusters or burning them with a kerosene torch. Both methods proved tedious, and so would be expensive if employed on a large scale. For burning to be effective, it was necessary to reduce the leaf clusters almost to ash, and many of the plants treated in this way showed distinct injury in the following spring.

Leach (J. G.), Hodson (A. C.), Chilton (St. J. P.) & Christensen (C. M.). **Observations on two Ambrosia Beetles and their associated Fungi.**—*Phytopathology* **30** no. 3 pp. 227–236, 4 figs., 16 refs. Lancaster, Pa., 1940.

An account is given of a study carried out during 1934–38 in Minnesota on the fungi associated with the Scolytids, *Trypodendron retusum*, Lec., in aspen (*Populus tremuloides*) and *T. betulae*, Swaine, in birch (*Betula papyrifera*). In nearly all cases, attack by *T. retusum* was confined to the lower half of the tree, being heaviest nearest the base. The adults hibernate, and they begin to tunnel in the trees and oviposit about the middle of May. The resulting larvae complete the pupal stage in early July, and the new adults leave the trees in late summer or early autumn. It was not determined where the beetles survive the winter, but all available evidence indicates that they do not hibernate in the trees. The life-cycle of *T. betulae* is very similar to that of *T. retusum*. The fungi on which the larvae feed, and which are introduced by the beetles into the galleries, are considered by the authors to be strains of *Monilia candida*. It was not determined how the fungus survives within the beetles over winter, but it is thought that spores remain in the intestinal tract during hibernation and are voided with the excreta when the beetles begin to tunnel in the spring.

Leukel (R. W.). **Selenized Soil as a Control for Aphids and Red Spiders on Sorghum in the Greenhouse.**—*Phytopathology* **30** no. 3 pp. 374–376, 1 fig., 2 refs. Lancaster, Pa., 1940.

Since greenhouse studies on diseases of *Sorghum* in the United States are frequently complicated owing to infestation of the plants by *Aphis maidis*, Fitch, and *Tetranychus telarius*, L., the author carried

out experiments in 1939 to determine the effect on infestation of selenium in soil in which *Sorghum* was grown. After 2 weeks, the average height of the plants in soil containing 5, 10 and 15 p.p.m. selenium was reduced by 19, 43 and 50 per cent., respectively, compared with that of the control without selenium. All attempts to infest these plants with the Aphid or mites were unsuccessful, while the controls became severely infested and damaged. Plants in soil containing 2, 3 and 4 p.p.m. selenium showed no reduction in height after 4 weeks. Slight infestation and injury by *Tetranychus* occurred on plants in soil with 2 and 3 p.p.m. selenium, but those in soil with 4 p.p.m. selenium remained free from mites and Aphids. The *Sorghum* grown in the soil with selenium formed normal heads and seed after 14 weeks, while the plants in the control soil were stunted and had produced no heads. In view of the fact that it is extremely poisonous, selenium should in no circumstances be used as here described to treat plants intended for other than experimental purposes.

VALLEAU (W. D.). **Sweetclover, a probable Host of Tobacco Streak Virus.**—*Phytopathology* **30** no. 5 pp. 438–440, 2 refs. Lancaster, Pa., 1940.

Observations in Kentucky indicated that sweet clover (*Melilotus alba*) is probably the plant from which an insect vector carries the virus of streak to tobacco growing in the vicinity.

MOSES (C. S.) & HOFFMANN (C. H.). **Isolation of *Ceratostomella ulmi* from *Scolytus multistriatus* Adults stored at different Temperatures.**—*Phytopathology* **30** no. 8 pp. 701–702, 1 ref. Lancaster, Pa., 1940.

An experiment was carried out to determine the most satisfactory temperatures for storing adults of *Scolytus multistriatus*, Marsh., contaminated with *Ophiostoma* (*Ceratostomella*) *ulmi*. It was found that all temperatures tested (70, 60, 40, 28 and −10°F.) were adequate if the material was not kept longer than 60 days. A temperature of −10°F. was, however, the most satisfactory on the basis of rapidity of coremial development and freedom from contaminants.

HASEMAN (L.). **The Walnut Caterpillar.**—*Bull. Missouri agric. Exp. Sta.* no. 418, 14 pp., 11 figs., 6 refs. Columbia, Mo., 1940.

In 1937, an outbreak of *Datana integerrima*, G. & R., occurred on black walnut [*Juglans nigra*], pecan and hickory in Missouri, and almost all the trees were completely defoliated. Most of the damage, however, was caused by larvae of the second generation, and consequently the trees did not suffer permanent injury. This Notodontid was again abundant in 1938, but in 1939 the population was much reduced. In the latitude of central Missouri, *D. integerrima* has normally only one generation a year or occasionally a partial second, but in favourable years, such as 1937 and 1938, it has two complete generations, as it usually does farther south. All stages and the process of larval development are described.

The pupae overwinter in the soil at depths of at least an inch, and in 1938 the adults began to emerge at Columbia during late May.

Females were observed resting on the walls of buildings during the day, and were less attracted to lights at night than the males. Oviposition commenced early in June and continued for at least two weeks. Hatching began on 11th June, and between 15th and 17th June large numbers of newly hatched colonies of larvae were collected. Adults of the summer generation emerged between 8th and 18th August, whereas in 1937 emergence continued throughout most of August. The eggs are deposited in masses of from 100 to over 1,200 on the lower surfaces of the leaves and hatch in about a week. The larvae feed gregariously on the upper surface of the leaves and pupate after 20–30 days under favourable conditions. The full-fed larvae drop or crawl to the ground, where they seek a place to pupate in the soil or under litter. During this period, many of them are attacked by parasites, especially Tachinids. The pupal stage in the first generation lasts 9–21 days. The most effective parasites were *Telenomus ichthyurae*, Ashm., and *Trichogramma minutum*, Riley, which attack the eggs. In 1937, only a small proportion of the eggs were parasitised, although in some of the second-generation batches 40 per cent. of the eggs did not hatch. In 1938, the percentage parasitism was still low in the first generation, but ranged up to 50 in the second, and *Trichogramma* parasitised more eggs than *Telenomus*. It is considered, however, that parasitism alone could not have accounted for the rapid decline in numbers of *D. integerrima* in the autumn of 1938 and in 1939. Other parasites reared in small numbers were the Ichneumonids, *Heteropelma datanae*, Riley, and *Anomalon* (*Paranomalon*) *relictum*, F., which attack the larvae and of which the latter was occasionally observed ovipositing in individuals in the third and fourth instars. Larvae in search of pupation sites were heavily attacked in 1938 by the Tachinid, *Phorocera claripennis*, Macq.

Control measures against *D. integerrima* are necessary only when it is abundant enough to cause serious damage to foliage. Since the females are poor fliers and deposit most of their eggs on the lower limbs, so that the larvae do not reach the upper parts of the tree until the later instars, even large trees can be protected by early spraying from the ground to a height of 20–30 ft. One application of lead arsenate at the rate of 1–2 lb. per 50 U.S. gals. water is usually sufficient. Destruction by hand is also effective, and infested twigs should be removed by clipping, or burnt off by means of an improvised torch, before the larvae move to the upper parts of the tree.

Gonçalves (C. R.). **Observações sobre** *Pseudococcus comstocki* **(Kuw., 1902) atacando** *Citrus* **na Baixada Fluminense.** [Observations on *P. comstocki* attacking *Citrus* in the Lowlands of Rio de Janeiro.] —*Rodriguesia* **4** no. 13 pp. 179–198, 19 pls., 19 refs. Rio de Janeiro, 1940. (With a Summary in English.)

An account is given of observations carried out in 1937–39 in the lowlands of the State of Rio de Janeiro, Brazil, where the roots of *Citrus* trees, particularly orange, are attacked by a disease attributed to the symbiosis of the mealybug, *Pseudococcus comstocki*, Kuw., and a fungus that is almost certainly *Boletus tropicus*, since sporophores of this species invariably appear on the soil surface immediately above the point of attack, so that their presence can be accepted as a sure sign of injury. This subterranean attack is very harmful to the trees,

which are greatly weakened and sometimes killed if the mycelian crusts formed over the mealybugs are numerous, but it is accidental, as *P. comstocki* normally infests the leaves. It prefers those that are folded or curled, such as occur in cases of previous infestation by *Toxoptera aurantii*, Boy., owing to the shelter they afford. In their search for dark sheltered sites, some females descend the trunk, enter nests of *Solenopsis moelleri*, Forel, near the root collar and are carried by the worker ants into the interior. These females establish themselves on parts of the roots that have been uncovered by the ants, and found colonies of mealybugs that become covered by the fungus crust.

The adult female of *P. comstocki*, which is normally oviparous, but sometimes produces living young, is briefly described. The mealybugs excrete honey-dew in such quantity that a sooty fungus of the genus *Capnodium* soon appears on the leaves, often followed by another fungus, *Septobasidium pseudopedicellatum*. The injury to the leaves, however, is not serious. Several species of ants feed on the honey-dew, but *S. moelleri* is the only one that colonises the mealybug on the roots. Both the mealybug and *S. moelleri*, the nests of which are briefly described, are most abundant during the dry season from May to December.

The natural enemies of *P. comstocki* observed by the author were four Coccinellids, of which two species of *Scymnus* were the most important, larvae of a Chrysopid and a Pyralid, and a Chalcidoid endoparasite. The mealybug was common on the leaves of sweet orange and grapefruit, and on the roots of orange and Rangpur lime (*Citrus aurantifolia*) used as stocks. *Solenopsis moelleri* does not nest in compact, clay soils, and the roots of *Citrus* in them are consequently free from infestation by the mealybug and the fungus.

Experiments showed that *P. comstocki* could be controlled on the roots by watering the surface of the soil with a 3 per mille solution of sodium cyanide or a 2·5 per mille emulsion of carbon bisulphide used at the rate of 2 gals. per sq. yard. The infestation cannot be eradicated, however, unless *S. moelleri* is also destroyed. The best method of doing this was to pour a stream of 5 per mille creolin emulsion into the nests in August or September. Watering the nests with a 0·5 per mille solution of sodium or potassium cyanide was also effective.

MILANEZ (F. R.). **Observações sobre uma estranha doença das laranjeiras.** [Observations on a strange Disease of *Citrus* Trees.] —*Rodriguesia* **4** no. 13 pp. 199–263, 19 pls., 7 figs., 35 refs. Rio de Janeiro, 1940.

The author has received from C. R. Gonçalves roots of Rangpur lime (*Citrus aurantifolia*) infested by *Pseudococcus comstocki*, Kuw., and *Boletus tropicus* [*cf.* preceding abstract]. He concludes from a detailed study of this material that the symbiosis of the mealybug and *Boletus* is not the primary cause of the death of the roots, but that the latter are also attacked by another fungus that is parasitic on them and forms an association of the mycorrhiza type. The relation between this fungus and the plant is described as an unstable equilibrium, which is upset in favour of the fungus by any factor that reduces the resistance of the plant. Infestation by the mealybug, which sucks the plant juices, and *Boletus*, which injures the surface tissues, is such a factor.

Blanchard (E. E.). **Apuntes sobre muscoideos argentinos.** [Notes on Argentine Muscoids.]—*An. Soc. cient. argent.* **129** pt. 5 pp. 224–246, 5 figs. Buenos Aires, 1940. (With a Summary in English.)

Six new Tachinid genera are erected, and five new species, each in one of the new genera, are described. They include *Parabrachycoma ruficauda*, reared from pupae of *Alabama argillacea*, Hb., and *Chaetolixophaga laspeyresiae*, from larvae of *Cydia* (*Laspeyresia*) *molesta*, Busck.

Stahel (G.) & Geijskes (D. C.). **De Parasolmieren en hunne bestrijding.** [Leaf-cutting Ants and their Control.]—*Bull. Dep. LandbProefst. Suriname* no. 56, 26 pp., 2 pls. Paramaribo, 1940.

Two leaf-cutting ants, *Atta cephalotes*, L., and *A. sexdens*, L., are serious pests in Dutch Guiana, the former chiefly attacking coffee and *Citrus* and the latter cassava. An account is given of the organisation and economy of their colonies, and the construction of their nests is described [*cf. R.A.E.*, A **27** 567]. The nests of *A. cephalotes*, being close to the surface, can be destroyed by digging up the soil and watering it so that the ants suffocate in the resulting mud. The usual measure against both species is fumigation with carbon bisulphide [*loc. cit.*], but a mixture of sulphur and arsenic is also effective [**23** 750].

Jenkins (C. F. H.). **The Small Plague Grasshopper,** *Austroicetes cruciata*, **Sauss. with some Notes on Egg Parasites occurring in Western Australia.**—*J. Dep. Agric. W. Aust.* (2) **17** no. 2 pp. 234–240, 4 figs., 7 refs. Perth, W. A., 1940.

The breeding habits and life-history of *Austroicetes cruciata*, Sauss. (*jungi*, Branc.) in Western Australia are briefly described and control measures discussed [*cf. R.A.E.*, A **26** 169, 584]. The commonest parasite of the eggs is *Cyrtomorpha flaviscutellaris*, Roberts [**27** 56]; larvae of this Bombyliid collected from egg-pods in May and July and kept at room temperature did not give rise to adults until December and January, after a pupal period of about 3 weeks. This parasite is of no great economic importance, since the percentage of egg-pods parasitised by it in no case exceeded 15. In 1939 and 1940, some egg-pods of *A. cruciata* in Western Australia were parasitised by larvae of *Scelio chortoicetes*, Frogg., the female of which is briefly described. Control measures include the ploughing up of areas suitable for oviposition, so as to destroy the eggs and prevent further egg-laying, which takes place only on hard uncultivated soil. The hoppers can be destroyed by sprays or baits containing sodium arsenite [**26** 169] and the younger ones by contact sprays of hot soap solution applied in the early morning while they are inactive. A spreader for distributing the baits, which is attached to a motor truck, is described and figured.

Lever (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **11** no. 2 pp. 38–42, 1 fldg pl., 14 refs. Suva, 1940.

The Scolytid infesting *Endospermum* in Viti Levu [*R.A.E.*, A **26** 702] has been identified as *Xyleborus rameus*, Schedl. Other Scolytids recorded in Fiji include *X. perforans*, Woll., from coconut trunks, *X. testaceus*, Wlk., from twigs of *Hydnocarpus* sp. and trunks of *Citrus*,

X. morstatti, Hag., and *X. mutilatus*, Bldf., from avocado, *X. aplanatideclivis*, Schedl, from avocado and *Inocarpus*, *X. compactus*, Eichh., from shoots of *Clidemia hirta*, and *Cryphalus jatropha*, Samps. [? M.S.] from stems of the ornamental *Acalypha wilkesiana*. Infestation of avocado has been well controlled by severe pruning and the application of a paint composed of ½ pint crude carbolic acid and 1 lb. soap in 3 gals. water. The Platypid, *Crossotarsus saundersi*, Chapuis, has been found boring in the branches of avocado and in the trunk, at ground level, of a grape-fruit tree growing among long grass on undrained soil. Stacked piles of mangrove (*Bruguiera gymnorrhiza*) were attacked by *Parendymia pilipes*, Kirsch, in February 1939; this weevil oviposits in logs, into which the larvae bore, and infestation is therefore believed to have begun in the timber-yard. The Bostrychid, *Xylothrips religiosus*, Boisd., was recently recorded from shoots of mahogany (*Swietenia macrophylla*), one of which contained as many as 8 adults in a single cavity, and in branches of avocado; in Samoa, it infests bread-fruit [*Artocarpus incisa*] and *Hibiscus tiliaceus*. *Xylopsocus castanoptera*, Fairm., attacks *Poinciana* (*Delonix*) *regia* in Fiji, but is of small importance, and *Dinoderus minutus*, F., bores in the internodes of bamboo.

In 1917, leaves of maize were reported to be mined by a species of *Phytomyza* [**6** 475]. This Agromyzid again caused fairly severe damage to maize in October 1939 and was identified as *P. spicata*, Mall., which also attacks sugar-cane and *Sorghum halepense* in Fiji. The larvae make blister-like mines running parallel to the veins and pupate in them or in the soil. They are heavily parasitised by a Eulophid of the genus *Hemiptarsenus*, which in one district destroyed 75 per cent. The pupae are parasitised by a Cynipid of the genus *Eucoila*, which, however, exerts negligible control. A spray of 1 part nicotine sulphate in 500 parts soap solution killed the larvae in their mines, but also destroyed the developing parasites.

Nezara viridula, L., was recorded for the first time in Fiji at the end of 1939, when it was taken in three localities in Viti Levu, on cowpeas, on cotton and in houses at night, respectively. The nearest places to Fiji in which it is known to occur are the Tonga Islands, Queensland and New South Wales. Two days after it was reported in Fiji, a ship taking a consignment of this Pentatomid parasitised by the Tachinid, *Trichopoda pennipes*, F., from Florida to Sydney arrived at Suva. The author removed a few of the parasitised bugs, but they very soon died as a result of having been twice subjected to refrigeration.

The Eulophid, *Syntomosphyrum indicum*, Silv., which was introduced for the control of *Dacus* (*Strumeta*) *passiflorae*, Frogg., in 1938 [*cf.* **26** 702], when 8,000 were reared and liberated, was recovered from fruit-fly pupae in the field in March 1940.

In view of the recent increased cultivation of *Colocasia esculentum* in Fiji, brief notes are given on the insects that attack it there. The most important is the Sphingid, *Hippotion celerio*, L., the larvae of which sometimes completely defoliate the plants. In September 1939, when sweet potatoes were also attacked, an outbreak on Kandavu was controlled by applications of a bran bait poisoned with calcium arsenate and a spray containing arsenious oxide. The Delphacid, *Megamelus proserpina*, Kirk. [*cf.* **26** 213] caused considerable damage in the same district in June; the predacious Capsid, *Cyrtorhinus fulvus*, Knight, is usually associated with it, but does not appear to exert much control in Fiji. Occasional pests include the larvae of *Prodenia litura*, L., which

can be controlled by poison bran baits, and *Aphis gossypii*, Glov., which is usually checked by Syrphids and Coccinellids and is easily destroyed by a spray of kerosene emulsion. Attention is drawn to the danger of the introduction of Dynastids of the genus *Papuana*, which damage the underground parts of the plant in the Solomons [**23** 281] and the Gilbert and Ellice Islands [**27** 366].

Okamoto (D.). **Effectiveness of Lead Arsenate and Bordeaux Mixture in repelling** *Holotrichia morosa* **Waterh.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **12** no. 2 pp. 43–56. Tokyo, 1940.

Adults of *Lachnosterna* (*Holotrichia*) *morosa*, Waterh., were abundant in Korea in 1939. They emerge in July and August, appear above the ground for an hour or two after sunset at intervals of two days, and are present until early December. They feed on the leaves of mulberry, cherry, apple and pear, but in experiments fed very little on plum and grape-vine. The eggs are laid singly and hatch in about a week in summer. The larvae feed on the subterranean parts of wheat and vegetables, and apparently complete their life-cycle in two years. In experiments in a breeding cage, the adults fed on cherry leaves sprayed with calcium arsenate alone or mixed with lime-sulphur, but not on those sprayed with lead arsenate, Bordeaux mixture, or Bordeaux mixture and calcium arsenate.

Yamazaki (T.). **On the Life-history of** *Acanthocoris sordidus* **Thun.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **12** no. 2 pp. 57–68, 4 figs. Tokyo, 1940.

Descriptions are given of all stages of *Acanthocoris sordidus*, Thnb., which caused damage to sweet potato in Saitama Prefecture north of Tokyo in 1938 [*cf. R.A.E.*, A **27** 446] and also attacks potato, tomato and egg-plant [*Solanum melongena*]. This Coreid overwinters in the adult stage among fallen leaves and dry grasses, and has one generation a year. The overwintered adults begin to feed in May, and some survive until August. Females begin to oviposit in June, one day after pairing, and lay about 55 eggs in 1–7 batches, usually on the lower surfaces of leaves. The eggs hatch in 8–17 days. The nymphs are commonest in June and July, and reach the adult stage in an average of 52·6 days. The adults enter hibernation in November. The control measures recommended are hand collection in the early morning, when the bugs are inactive, spraying with derris in soap solution, and dusting with a mixture of pyrethrum and ash.

Kono (H.) & Sugihara (Y.). **Observations on the Oviposition of** *Porthetria dispar* **L.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **12** no. 2 pp. 69–74, 2 figs. Tokyo, 1940.

An account is given of observations at Sapporo on the oviposition habits of *Lymantria* (*Porthetria*) *dispar*, L., during a recent outbreak in Hokkaido. Its egg masses were scarce on most trees, but abundant on hedges of larch (*Larix*). They occurred mostly among dense foliage at the base of larches surrounded by grass and were most numerous within 16 ins. of the ground. Very few occurred at heights greater than 32 ins.

IJIMA (K.). **Effect of high Temperature upon the Fecundity of** *Eucosma schistaceana* **Snell. On the Sterility of Adults caused by natural high Temperatures.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **12** no. 3–4 pp. 81–105. Tokyo, 1940.

The experiments described were carried out at Tainan, Formosa, in view of the fact that eggs of the sugar-cane borer, *Eucosma schistaceana*, Sn., laid between 1st and 16th July in 1938 did not hatch. They showed that when this Tortricid is exposed to high temperatures (31–32°C. [87·8–89·6°F.]) during development, the resulting males are sterile, and that the eggs deposited by females that pair with them do not hatch.

KISHIDA (K.). **A Mite injurious to Silkworm.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **12** no. 3–4 pp. 113–116, 2 figs. Tokyo, 1940.

A brief description is given of a mite of the genus *Macrocheles* that was observed attacking silkworms [*Bombyx mori*, L.] in Kyoto Prefecture, Japan. The mites concentrated on the venter near the hind end, and most of the infested silkworms died.

KAMIYA (K.). **On the natural Enemies of** *Apanteles liparidis* **Bouché.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **12** no. 3–4 pp. 120–122. Tokyo, 1940.

Apanteles liparidis, Bch., which parasitises *Dendrolimus spectabilis*, Btlr., and *Lymantria dispar*, L. [*cf. R.A.E.*, A **27** 209] in Japan, is itself parasitised by *Eurytoma appendigaster*, Swed., *Hypopteromalus apantelophagus*, Crwf., *Pleurotropis howardi*, Crwf., *Ceraphron* (*Calliceras*) *kamiyae*, Ishii, and the Ichneumonids, *Gelis* (*Pezomachus*) *asozanus*, Uch., and *Hemiteles kumamotensis*, Uch. The Ichneumonids attack it when it is a parasite of either host, but the others only when it parasitises *L. dispar*. The pupae are destroyed by *Crematogaster brunnea*, F. Sm., subsp. *matsumurai*, Forel, and an Othniid beetle.

ISHII (T.). **On the Natural Enemies of** *Ceroplastes rubens* **Mask.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **12** no. 3–4 pp. 122–124. Tokyo, 1940.

Ceroplastes rubens, Mask., which infests *Citrus* in Nagasaki, is parasitised there by *Microterys speciosus*, Ishii, and *Coccophagus japonicus*, Comp., while *Cheiloneurus ceroplastis*, Ishii, and *Marietta* sp. are hyperparasitic in it. *Scutellista cyanea*, Motsch., was imported from California for the control of this Coccid in 1924, but did not become established [*cf. R.A.E.*, A **15** 280].

KINOSHITA (S.) & ISHIKURA (H.). **Sizes of** *Calandra oryzae* **L. and environmental Conditions.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **12** no. 3–4 pp. 124–128, 2 figs. Tokyo, 1940.

The results are given of observations on the size of various parts of the body of adults of *Calandra oryzae*, L., bred in rice at 25°C. [77°F.] and various humidities. The lengths of the rostrum, thorax, elytra and hind femora and the width of the head decreased with a fall in humidity, and this decrease was more marked at humidities below 50–60 per cent. Similar decreases occurred when the moisture content

of the rice fell below 15 per cent. At 30°C. [86°F.] the decrease in size was somewhat greater than at 25°. In Kagoshima Prefecture, this weevil attacks dried sweet potato as well as rice, and adults bred on the former are larger than those reared on the latter.

YUASA (H.) & KOYAMA (T.). **Effect of different Food Plants upon the Development of** *Chlorops oryzae* **Mats.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **12** no. 3–4 pp. 128–129. Tokyo, 1940.

Observations in Japan showed that larvae of *Chlorops oryzae*, Mats., develop more quickly in grasses in which the ears are formed early than in those in which ear-formation occurs later.

KAWADA (A.) & SEKIYA (H.). **Observations on** *Pieris rapae* **L.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **12** no. 3–4 p. 129. Tokyo, 1940.

The numbers of all stages of *Pieris rapae*, L., decreased considerably near Tokyo for about 3 weeks after a typhoon that occurred on 1st September 1938. In summer, the larvae are attacked by a disease, but are less susceptible to it on *Cardamine hirsuta* than on field cabbage.

YAMAZAKI (T.). **On the Attractants of** *Gryllus*. [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **12** no. 3–4 pp. 143–144. Tokyo, 1940.

The crickets, *Gryllulus* (*Gryllus*) *mitratus*, Hagenbeck, and *Loxoblemmus haani*, Sauss., are serious pests of vegetables in Japan. In the laboratory, *G. mitratus* was killed by baits containing lead arsenate in 2–5 days, and in field tests these were not injurious to the plants.

KONO (H.). **On the Spring Host Plants of** *Prociphilus oriens* **Mordv.** [*In Japanese.*]—*Oyo-Dobuts. Zasshi* **12** no. 3–4 pp. 149–150. Tokyo, 1940.

In Hokkaido, *Prociphilus oriens*, Mordv., develops on the roots of *Abies* in summer, and overwinters on ash (*Fraxinus*) and lilac (*Syringa* sp.) [*cf. R.A.E.*, A **27** 211]. The sexuparae have also been observed in autumn on other trees, including *Styrax*, willow, lime (*Tilia*), *Celtis*, *Prunus* and privet (*Ligustrum*), but the fundatrices or the fundatrigeniae are unable to develop on them in the following spring.

GADD (C. H.). **Report of the Mycologist for 1939. A Tortrix Parasite.** —*Bull. Tea Res. Inst. Ceylon* no. 21 pp. 36–37. Talawakelle, 1940.

In late September and early October 1939, Mermithids that had been found on tea bushes were received from three estates in Ceylon ; all were females that had oviposited or were actually doing so. A box of larvae of the tea tortrix [*Homona coffearia*, Nietn.] was received from a fourth estate in October, and in it were two dead immature Mermithids. Within one of the larvae a coiled worm (apparently of the same species) was visible under the skin, extending the whole length of the body. The larva, which was placed on a tea seedling growing in a pot, died a few days later, but there was then no trace of the worm. Two worms were found at the bottom of the pot, however, and, when placed on soil, immediately began to bore into it. Material was

submitted to Dr. T. Goodey, who identified the adults as *Mermis nigrescens* and thought it probable that the larvae were of the same species. It appears that the females come above ground to oviposit during wet weather only. The eggs are deposited on leaves, to which they are attached by means of fine threads. They are ingested by insects (such as larvae of *Homona*) feeding on the leaves, and hatch within the intestine. The young worms then pierce the intestinal wall and enter the body cavity. After a time, they kill their hosts and escape into the soil, where they complete their development.

King (C. B. R.). **Report of the Entomologist for 1939.**—*Bull. Tea Res. Inst. Ceylon* no. 21 pp. 38–46. Talawakelle, 1940.

There was again no severe outbreak of the tea tortrix [*Homona coffearia*, Nietn.] in Ceylon during 1939 [*cf. R.A.E.*, A **28** 97], although several estates reported its presence during the second half of the year. Further liberations of the introduced Braconid parasite, *Macrocentrus homonae*, Nixon, were made in two districts where its presence was doubtful; investigations on its local distribution indicated that it is now widespread, and the percentage parasitism, determined from collections of larvae submitted for examination, was usually between 25 and 50. Evidence was obtained that it was present in the district of Peradeniya by the end of 1939. In view of the control afforded, regulations requiring the collection and destruction of the immature stages of *H. coffearia* [*cf.* **16** 447] have been rescinded. A Chalcid of the genus *Antrocephalus* parasitises the pupae of *Homona*, but is of no economic importance.

Infestation of tea by nettle grubs [Limacodids] was slightly higher than in 1938 but occurred on only 10 estates, on 5 of which spraying was adopted for control. The number and extent of the outbreaks in various districts of Uva Province in 1931–39 and in each month of 1939 are shown in tables. Parasites were plentiful in September and October; those recorded were the Braconids, *Apanteles* sp. on *Thosea cervina*, Moore, and *T. recta*, Hmps., *Fornicia ceylonica*, Wlkn., on *Natada nararia*, Moore, and *Rhogas* sp. on *N. nararia*, *T. cervina*, *T. recta* and *Narosa conspersa*, Wlk. *Rhogas* is a promising parasite, but becomes numerous only towards the end of the season. Attempts to breed it on other than its recorded hosts have so far been unsuccessful. Larvae parasitised by *Rhogas* cease to feed after about a week, and the adult parasites emerge about a fortnight later; the life-cycle lasts 3 and about 2 weeks at average temperatures of 71 and 79°F., respectively. The adults live for at least 7 weeks in a cool dark cage, with sugar and water, but fail to survive short spells in a refrigerator at about 41°F. The Tachinid, *Tricholyga sorbillans*, Wied., also parasitises *Natada nararia*; its life-cycle is completed in 4–5 weeks in the laboratory, and the adults survive for 5 weeks or more if provided with sugar and water, but it attacks too great a variety of hosts to be of much value in controlling any one. The life-cycle of *Apanteles* sp. lasts 22–31 days.

Little fluctuation occurred in the numbers of *Xyleborus fornicatus*, Eichh., which is always present on tea in areas to which it is climatically suited, although the damage caused is variable and more apparent after drought. Reference is made to work in progress on possible alternative food-plants of this Scolytid. It did not breed in the great majority of the plants tested, but the detailed results are to be published

later. The probability that phloem necrosis of tea is a virus disease has led to a search for insects that might be vectors. In addition to 8 species of Jassids and a large number of Coccids, one species of each of 6 other families of Rhynchota were taken on tea. They include the Aphid, *Toxoptera aurantii*, Boy., which is so common that it is unlikely that it is a vector. No thrips were found on tea in the field. *Tenuipalpus obovatus*, Donn., caused a certain amount of defoliation; 29 generations of this mite have been bred in the laboratory, but no males have been produced. Red ants (*Oecophylla smaragdina*, F.) caused annoyance on several low-country estates in 1939; they make nests in the tea by using the larvae to web the edges of the leaves together into a hollow ball in which they live. Nests do not occur in pruned fields, and should be destroyed as soon as they are formed by burning them or removing them after killing the ants with a fly-spray.

Rahman (K. A.). **Important Insect Predators of India.**—*Proc. Indian Acad. Sci.* **12** no. 3 Sec. B pp. 67–74, 10 refs. Bangalore, 1940.

A list is given of 24 Coleoptera, 10 Diptera, 4 Neuroptera, 4 Rhynchota, a Mantid and a thrips that are predacious on insects and mites of economic importance in India, showing the pests they attack and the localities in which they occur, together with brief notes on the life-history of some of them.

Tothill (J. D.). Ed. **Agriculture in Uganda.**—Demy 8vo, xvi+551 pp., 30 pls., 3 fldg diagr., 9 figs. London, Humphrey Milford, Oxford Univ. Pr., 1940. Price 20*s*.

This handbook provides a comprehensive survey of the conditions under which agriculture is carried on in Uganda. It includes information on the insect pests of most of the crops cultivated, much of which is published for the first time and which occupies some 107 pages. Most of it is by H. Hargreaves, but A. S. Thomas records pests of cacao, oil palm (*Elaeis guineënsis*) and *Hydnocarpus*, and Hargreaves, A. M. Gwynn and T. H. C. Taylor, alone or in collaboration, deal with those of cotton. About fifty pages are devoted to pests of cotton, and about forty to those of coffee. A brief account of invasions by locusts, the damage for which they are responsible and measures against them is given by G. H. E. Hopkins.

Notley (F. B.). **Entomologist's Report.**—*Rep. Coffee Res. Exp. Sta. Lyamungu, Moshi* **5** (1938) pp. 29–38, 7 graphs. Dar es Salaam, 1940.

The main part of the work of the Coffee Research Station at Moshi, Tanganyika Territory, in 1938 comprised investigations on the biological control of the coffee leaf-miners, *Leucoptera coffeella*, Guér., and the species provisionally identified as *L. daricella*, Meyr. [but since described as *L. caffeina*, Washbourn (*R.A.E.*, A **28** 406)]. The observations were made in two areas, in one of which the coffee was

unshaded and planted on a western slope, while in the other it was under heavy shade and sheltered [*cf.* **27** 127]. All the mined leaves were collected from five trees in each area in May 1938, again after three weeks and then at fortnightly intervals until the end of January 1939. The eggs of each species were counted, the two species were reared separately and daily records were kept of the numbers of moths and parasites that emerged.

In the unshaded plot, *L. caffeina* was absent in May and the numbers of eggs of *L. coffeella* averaged only 36 per tree. This average increased rapidly, however, until October, when a full count was impossible, but estimates from 200 mined leaves showed that it was 1,740 per tree and damage was serious. The numbers then decreased rapidly. Increases in the numbers of eggs deposited were regularly followed by decreases, and the rate of adult emergence varied in the same periodic manner, the numbers of moths representing from 10 to nearly 50 per cent. of the numbers of eggs in the same collections. The adult emergences showed a normal distribution round five peaks of varying size that occurred at intervals of about 45 days and appeared to represent separate generations. The interval between the first and second peak was rather longer than the others, but this is explained by the lower temperatures at that time of the year. The recorded emergences of the most important larval parasites of *L. coffeella*, *Atoposoma variegatum* var. *afrum*, Silv., *Achrysocharella ritchiei*, Ferrière, and *Apanteles bordagei*, Giard [*cf.* **25** 77] indicated that all three were present from the beginning of the observations, but did not become abundant for a considerable time. An increase in their numbers began in August, was checked slightly in September, and then proceeded rapidly until, in December, they brought the outbreak under control. *L. coffeella* completes a generation in about 47 days, and has a rate of increase, based on egg counts, of about 3 times per generation. *Atoposoma* and *Achrysocharella*, however, both complete a generation in about 23 days, and increase about 6 times per generation. Under these conditions, *L. coffeella* could not normally become epidemic in the presence of either parasite, and the fact that it does so is attributed to the combination of the short life-cycle of the parasites and the tendency for only one stage of the moth to be present at a time. The parasites are thus unable to increase in a given season until the stages of *L. coffeella* overlap sufficiently to ensure a constant supply of hosts. In the case examined, this did not take place until September.

The most important parasites that emerged in September–January from pupae of *L. coffeella* collected in the plot were a Braconid near *Hormius* [*cf.* **27** 127], which apparently parasitises full-grown larvae in their mines and larvae that have spun cocoons and may also attack pupae, *Pleurotropis coffeicola*, Ferrière [**25** 77] and *Apanteles bordagei*. In September, 81 per cent. of the pupae were unparasitised, but the percentage fell rapidly until in November it was only 10. This reduction was due almost entirely to *Hormius*, which emerged from an average of 68 per cent. of the pupae collected on 21st November and 5th December. No egg parasites were observed. It is concluded that *L. coffeella* was able to multiply almost unchecked until September, but that from then onwards, parasites became of increasing importance, the percentage of hosts that escaped parasitism in any stage falling from 68 in September to 55 in October and 7·6 in November. The parasites that emerge from the pupae exert the greatest degree of control. *L. caffeina* remained of slight importance in the unshaded

plot, and though the population followed the same course as that of *L. coffeella*, the egg counts showed a peak in November of only 63 per tree.

At the beginning of the observations on coffee under shade conditions, *L. coffeella* and *L. caffeina* were present in about equal numbers, and doing considerable damage. *L. coffeella* came under control almost immediately, and *L. caffeina* much more slowly. By the end of August both were rare. Immediately after this, a serious outbreak of *L. caffeina* occurred, egg counts reaching 1,600 per tree at the beginning of November, while *L. coffeella* also increased, but the egg population did not exceed 150 per tree. The egg counts of *L. caffeina* showed a second peak in early December, while those of *L. coffeella* showed peaks both then and in early January. The collections indicated that the late larval, prepupal and pupal parasites are of great importance in controlling *L. caffeina*, which, in their absence increases at the rate of about eight times per generation and may suddenly appear and cause very serious damage, sometimes amounting to almost complete defoliation. Since many of the parasites appear to be common to both species of *Leucoptera*, the presence of one of them will influence the other.

Investigations on *Antestia* were begun in the Ura and Meru districts in September and November, respectively ; in Meru, where the numbers of *Antestia* were small, *Corioxenos* [*antestiae*, Blair (*cf.* **26** 179)] was rare, whereas in Arusha, where the numbers were higher, the Stylopid was comparatively common. Although the numbers of *Antestia* at the experiment station were small, damage was severe ; the amount of injury caused is not constant for the number of bugs per tree, but depends on various factors, including the percentage of *Antestia* infected with *Nematospora* [*cf.* **26** 178]. It has been stated that control measures need not be applied until an average of two bugs per tree is recorded, but on this occasion a population of two per tree represented over 15 per cent. damage to the crop. Efforts are therefore being made at the station to prevent the average exceeding one per tree in any block.

HARRIS (W. V.). **The Locust Tracheal Mite.**—*E. Afr. agric. J.* **6** no. 1 pp. 43–44, 2 figs., 3 refs. Nairobi, 1940.

The original description of the non-gravid female of the tracheal mite, *Locustacarus locustae*, Ewing, found in 1932 on *Locusta migratoria migratorioides*, R. & F., in Tanganyika Territory is quoted [*R.A.E.*, A **20** 572], and the gravid female is briefly described. This Tarsonemid was again observed on *L. m. migratorioides* in Tanganyika Territory in 1933, and has recently been reported from Kenya. The young mites are active and may be found on the outside of the locusts, but eventually penetrate into the spiracles and settle in the tracheae and air sacs. No males have so far been found, and it is possible that reproduction is parthenogenetic. The females are adult when they hatch from the eggs. Hopes that this mite would be useful in natural control did not materialise, for all the heavily infested swarms were found to have already oviposited, but information from other parts of the distribution area of *L. m. migratorioides*, where the multiplication of the mite may be more rapid, is required before it should be considered useless.

Fraenkel (G. S.) & Gunn (D. L.). **The Orientation of Animals. Kineses, Taxes and Compass Reactions.**—Demy 8vo, viii+352 pp., 135 figs. (10 pls.), 19 pp. refs. Oxford, Clarendon Press, 1940. Price 21*s*.

This book deals in a comprehensive way with the orientation of animals, including a systematic treatment of the factors and reactions responsible for the direction of movements guiding them into their normal habitats, and thus determining their ecological distribution on the basis of behaviour. The experiments and observations summarised very largely concern insects.

Campbell (W. G.) & Bryant (S. A.). **A Chemical Study of the Bearing of Decay by *Phellinus cryptarum* Karst. and other Fungi on the Destruction of Wood by the Death-watch Beetle (*Xestobium rufovillosum* De G.).**—*Biochem. J.* **34** no. 10–11 pp. 1404–1414, 18 refs. London, 1940.

The following is based on the authors' summary of investigations on the effect of decay by *Phellinus cryptarum* and other fungi on the availability of oak sapwood to larvae of *Xestobium rufovillosum*, DeG., some of the more important results of which have already been noticed [*R.A.E.*, A **28** 452]. *P. cryptarum* causes a white rot of the class in which all of the major components of wood are decomposed simultaneously. The food of larvae of *X. rufovillosum* consists of extractives, cellulose, hemicelluloses and lignin, and there is no specific type of fungous decay that predisposes oak wood to attack. Although decayed wood is the commonest habitat of *Xestobium*, this is not due to the relative abundance or availability of any particular food component resulting from fungous activity.

The wood digested by a group of larvae expressed as a percentage by weight of the wood disintegrated during boring by the same group is termed the "abstraction coefficient." It is independent of the number of larvae in the group and also of the time taken by the group to disintegrate any given weight of wood, and is accepted as a direct measure of the amount of energy abstracted by the larvae per unit weight of wood disintegrated. As the extent of fungous decay in the substrate increases, the numerical value of the abstraction coefficient diminishes over the range of loss of 26–73 per cent. of the dry weight of original wood caused by decay. It is concluded that the depreciation in mechanical strength of wood induced by fungous decay, and not a chemical modification of its components rendering it more digestible to the larvae, is the major factor responsible for the relatively more favourable development of the larvae in decayed wood. Decayed wood offers less resistance to larval boring than sound wood. During progressive fungous decay, the rate of decline in the strength of wood is greater than the rate of decline in density, and it is possible that the rate of decline in the larval abstraction coefficient is not so great as the rate of decline in the mechanical strength of the substrate; both these factors favour the energy metabolism of the larvae. It appears that the rate of larval boring increases with the extent of fungous decay in the substrate, and it is therefore possible that the larva may regulate its rate of boring, so that as the mechanical strength

of the substrate decreases it is enabled to increase its rate of abstraction and conservation of energy.

The relation between fungous decay and attack by *Xestobium* in structural timbers under natural conditions is discussed. It is concluded that in England oak wood infested by *Xestobium* is usually more or less decayed by fungi of the brown rot type, which are commoner in oak timbers in buildings than are white rots, that there is therefore no specific fungus that predisposes oak wood to attack, and that attack is not limited to wood that has attained any particular stage of decay.

ROBERTS (F. M.). **Studies on the Feeding Methods and Penetration Rates of *Myzus persicae* Sulz., *Myzus circumflexus* Buckt., and *Macrosiphum gei* Koch.**—*Ann. appl. Biol.* **27** no. 3 pp. 348–358, 2 pls., 7 refs. London, 1940.

Previous work on the transmission of *Hyoscyamus* virus 3, potato virus Y and cucumber virus 1 by *Macrosiphum solanifolii*, Ashm. (*gei*, auct.), *Myzus persicae*, Sulz., and *M. circumflexus*, Buckt., established that maximum infection is obtained after the Aphids have fed for only 2 minutes on infected plants, and that infectivity decreases rapidly with increased feeding periods on them [*R.A.E.*, A **28** 301, etc.]. The species were not uniformly efficient, however, in transmitting some of the viruses [**26** 615], and investigations on the manner and rate of penetration by their stylets in tobacco leaves were carried out by a technique described, in an attempt to determine the cause of these variations. Penetration by *M. persicae* in leaves of sugar-beet was also investigated, since the number of infections of sugar-beet yellows virus, of which it is the vector, did not decrease with increased feeding periods. It was found that *M. persicae* and *M. circumflexus* did not reach the phloem after feeding on tobacco for 5 minutes and very few of the former reached it after feeding on tobacco or sugar-beet for 15 minutes. A few Aphids did not penetrate to the phloem after feeding for as long as 24 hours. The stylets of *Macrosiphum solanifolii* and *Myzus persicae* penetrated the leaves by the intracellular method in more, and those of *M. circumflexus* in less, than half of the material examined. *Macrosiphum solanifolii* penetrated to the phloem more frequently in feeding times ranging from 1 to 24 hours than the other species.

The efficiency of the Aphids as vectors of the *Hyoscyamus*, potato and cucumber viruses thus does not appear to depend on the localisation of these viruses in the vascular tissue [*cf.* **22** 525]. In general, infectivity did not seem to be associated with any particular leaf tissue tapped during feeding or with any particular method of penetration. It is possible, however, that cucumber virus 1 may be an exception, and that its localisation, or availability to the insect, may explain the fact that, unlike the other two viruses, it is transmitted more readily by *Myzus circumflexus* than by *M. persicae* and that the latter does not show the typical decrease in infectivity between feeding periods of 5 and 15 minutes, and sometimes does not attain maximum infectivity until it has fed for 15 minutes on an infected plant [**26** 615]. There was some evidence of such localisation, since the penetration by *M. circumflexus* was 57μ, whereas that of *M. persicae* was only 47–52μ; the intercellular method of penetration exhibited by the former may also enable it to reach tissues in which

the virus is concentrated more readily than *M. persicae*, which penetrates intracellularly.

The results of unpublished experiments on the transmission of the sugar-beet yellows virus by *M. persicae* have shown that the shortest time of total feeding in which infection was obtained was 30 minutes ; it rarely occurred when the Aphids had fed on infested plants for 7 minutes and only when the feeding time on healthy plants was prolonged. The percentages of successful transmission increased with the feeding period on the infected plants and also, independently, with the period on the healthy ones. The fact that the number of penetrations to the phloem also increased with increased feeding time suggests that feeding in phloem is essential for infectivity, but other factors, such as the amount of virus ingested, are also concerned and may be wholly responsible.

No toxic reaction to the saliva of the Aphids was observed in either sugar-beet or tobacco [*cf.* **14** 188].

THOMAS (I.) & VEVAI (E. J.). **Aphis Migration. An Analysis of the Results of Five Seasons' Trapping in North Wales.**—*Ann. appl. Biol.* **27** no. 3 pp. 393–405, 5 graphs, 15 refs. London, 1940.

The climatic factors governing the migration of Aphids were investigated in North Wales from data obtained by means of a water-power mechanical insect trap [*R.A.E.*, A **24** 112] that was operated between the end of May and the middle of August in each year from 1935 to 1939, inclusive, during which periods Aphids of 76 species were caught. The numbers of each trapped in each year and the more important synonyms of 15 species of economic importance are shown in tables. Large-scale migrations took place when the wind was from the north-east and its velocity was low (generally less than 2 miles per hour), the maximum temperature exceeded 75°F., and the relative humidity was less than 80 per cent. [*cf.* **23** 492 ; **24** 551, etc.]. Wind velocity appears to be the most important limiting factor, and very few Aphids were trapped when it rose above 5 m.p.h. The numbers caught during June in each year are discussed with reference to the prevailing climatic conditions ; large-scale migrations took place in 1935, 1936 and 1939, whereas there was little movement in 1937 and only 12 Aphids were trapped in 1938.

On several occasions in 1937 and 1939, very few Aphids were caught when conditions were favourable, and this was attributed to a scarcity of alates. A study was therefore made of the meteorological conditions for a month prior to large flights and for May in years in which few Aphids were trapped in order to ascertain those that probably affected wing formation [*cf.* **14** 358 ; **16** 372 ; **19** 557 ; **27** 323]. Alates were produced in large numbers when the month had a high proportion of dry sunny days tending towards drought conditions and the fluctuations in daily temperature exceeded 12°F. Two species were trapped in large numbers only in 1939 when there was a long period of drought during May and June, and although the effect of such a period on the food-plant is probably an important factor governing the production of alates, the food-plant of one of them is oak, which is unlikely to have been seriously affected, and the increased abundance of this Aphid was probably due to the direct effect of the meteorological conditions upon it.

[Popov (K. I.).] **Попов (К. И.). The Effect of ecological and agro-technical Conditions on the Behaviour and Injuriousness to Flax of the Flea-beetles** *Aphthona euphorbiae* **Schrank and** *Longitarsus parvulus* **Payk.** [*In Russian.*]—*Trud. Obshch. Estestvoisp. Kazan. Gosud. Univ.* **55** no. 3–4 pp. 157–203, 1 map, 2 graphs, 44 refs. Kazan, 1939. (With a Summary in English.) [Recd. 1941.]

Investigations in Kazan on the bionomics of *Aphthona euphorbiae*, Schr., and *Longitarsus parvulus*, Payk., on flax were continued in 1936–37 with special reference to the effect of mulching on them. Previous observations [*cf. R.A.E.*, A **25** 575] showed that covering newly-sown flax with a layer of straw reduced injury by the flea-beetles at the time of sprouting by 37·8–83·8 per cent. depending on weather conditions. This was due to a reduction of the temperature at the surface of the soil to below the optimum for the flea-beetles, which was found to be 27–28°C. [80·6–82·4°F.].

In a series of field experiments in which various materials were used for mulching, the percentage infestations of sprouting flax were about 13–20 for straw, 44–50 for sand and sawdust, and 23–56 for loose black peat, and the difference in effectiveness between straw and peat was as great during the phase of stem formation. These results conformed to expectations, since straw was the only material tested that was impervious to light and the one that gave the lowest temperature at the surface of the soil. The effect of mulching on the microclimate of the soil surface was dependent on the physical structure of the material used, its colour, weather conditions and solar radiation. Temperatures above the optimum occurred on the soil surface at noon on hot days, and this caused the beetles to crawl on to the cotyledons of sprouting flax, so that injury by them was intensified. This behaviour was not affected by a mulch of peat, but when straw was available the beetles tended to concentrate on it in hot weather and not on the cotyledons of the flax. During the phase of stem formation, mulching with straw was less effective and sometimes even detrimental, as young leaves were formed above the level of the straw and were destroyed by the beetles.

A comparison of data on the occurrence of the two species on flax in European Russia shows that their relative abundance varies considerably from year to year, which indicates that they differ in ecological requirements. From a detailed study of their development near Kazan in 1935–1936 the author concludes that *A. euphorbiae* survives within a wide range of temperature and humidity; though favoured by warm and moist conditions, it also thrives at relatively low temperatures if the humidity is high and can withstand high temperatures combined with dryness. *L. parvulus* finds optimum conditions at medium temperatures and a relatively high humidity, whereas high temperature, especially if combined with dryness of the soil, is fatal to the pre-adult stages.

A brief review of the world distribution of both species shows that *A. euphorbiae* occurs over most of Europe, including almost the whole of European Russia, and extends into the Russian Far East. *L. parvulus*, on the contrary, is restricted to the forest and steppe-forest zone and is absent from the south and south-east of European Russia, where the summer is hot and droughts are frequent. In the central area, where both species occur, *L. parvulus* predominates in cool wet summers, whereas in hot dry summers it is almost completely replaced

by *A. euphorbiae*. The relative frequency of the two species on flax also depends on the date of sowing; *L. parvulus* predominates on early sown crops, which develop under conditions of low temperature and high humidity, whereas *A. euphorbiae* is the more abundant on late sowings.

VAN DER GOOT (P.). **Dierlijke vijanden van djengkol en peteh.** [Pests of *Pithecolobium lobatum* and *Parkia speciosa*.]—*Meded. algem. Proefst. Landb.* no. 46, 13 pp., 3 pls.; also as *Meded. Inst. PlZiekt.* no. 99. Buitenzorg, 1940. (With a Summary in English.)

The most important pests of the seeds of *Pithecolobium lobatum* and *Parkia speciosa* in West Java, where they are used as food by the natives, are the weevil, *Tryphetus incarnatus*, Gylh., the Tortricid, *Argyroploce illepida*, Btlr., and the Pyralid, *Mussidia pectinicornella*, Hmps. Their bionomics and the morphology of all stages are briefly described. Infestation by *T. incarnatus* is apparently confined to *Pithecolobium* and to the mature pods, but up to 75 per cent. of the seeds are damaged by the larvae towards the end of the dry season. The attack is much less during the rainy season, but continues in stored seeds. The average durations of the egg, larval and pupal stages were 5, 18 and 7 days, respectively, and males and females survived for 54 and 67 days. Infestation can be avoided by harvesting the seeds while the pods are still unripe, but the market value of such seeds is about 20 per cent. less than that of ripe ones. The seeds are often stored in pits about 20 ins. deep for 6–9 weeks, and it is then advisable to free them from infestation before storage by fumigation for 24 hours with carbon bisulphide at the rate of 1 fl. oz. per 40 cu. ft., which destroys all stages of the weevil and does not harm the seeds.

A. illepida occasionally infests *Parkia* and damages about 15 per cent. of the seeds of *Pithecolobium*. The infestation of the ripening seeds occurs throughout the whole crop season and is only slightly less during the rainy season. The periods when seeds of *Pithecolobium* are not available appear to be bridged by alternative food-plants, which include Lima beans and probably other Leguminosae. The larvae leave the seeds when they are full-fed, and infestation does not occur in storage. The durations of the egg, larval and pupal stages averaged 4, 16 and 9 days, respectively, and females survived for 15 days. The preoviposition and oviposition periods averaged 10 and 4 days, and the numbers of eggs laid per female ranged up to 149 and averaged 48. Considerable mortality (30–50 per cent.) occurs in the larval stage.

Larvae of *M. pectinicornella* bore in the half ripe seeds of *Parkia speciosa* throughout the year. The injury is not visible until the pods are opened, but the percentage of seeds damaged ranges up to 75 during the dry season and 20–30 during the rains. The larval and pupal stages lasted about 15 and 8 days, respectively, and though no eggs hatched in the laboratory, it is estimated that development from egg to adult lasts about 28 days. Females did not survive for longer than a week and deposited an average of only 20 eggs. Pupation takes place in the ground. No control measures seem practicable owing to the great height of the trees.

PRUTHI (H. S.). **Report of the Imperial Entomologist.**—*Sci. Rep. agric. Res. Inst. New Delhi 1938–39* pp. 116–133. Delhi, 1940.

An account is given of work on insects of economic importance in India in 1938–39, some of which has already been noticed [*R.A.E.*, A **27** 575; **28** 507, 511]. Observations on the Ichneumonid, *Goryphus* (*Melcha*) *nursei*, Cam., which parasitises the pupae of *Earias* spp. on cotton, showed that the egg stage lasted 24–28 and 20–24 hours at 25 and 30–35°C. [77 and 86–95°F.], and the larval and pupal stages 4 and 10–11 days at 25°C. and 3 and 7–8 at 30°C. Larvae and pupae failed to develop at 35°C. As many as 121 host pupae were paralysed by a single female, which laid 164 eggs on them. The maximum number of eggs laid at 35°C. was only 55, and they were deposited on 46 pupae.

Leaf-curl of tobacco was found to be more widely distributed in northern India than was previously known. Work on the transmission of the disease by *Bemisia tabaci*, Gennadius (*gossypiperda*, Misra & Lamba) [**28** 2] was confirmed, and in a series of large-scale experiments it was transmitted by this Aleurodid to tobacco from tomato, *Zinnia elegans*, *Solanum nigrum*, *Euphorbia hirta*, *Vernonia cinerea*, *Launea asplenifolia*, *Sida rhombifolia* and *S. humilis*. The virus was transmitted by the feeding of only a single individual of *B. tabaci*, and after a minimum feeding period on the diseased source of one hour. The Aleurodid was observed feeding on about 75 different plants, the great majority of which showed some curling of the leaves. Thus, control of the disease by the eradication of alternate hosts is impracticable, and the aim should therefore be to protect the crop from infestation by the Aleurodid. It appears that infection of tobacco takes place in September, at which time the tobacco plants are still in the nurseries or have just been planted in the field. The Aleurodid passes through several generations from July to November, when it is commonest in the fields. It is again active in spring, but its numbers decrease in the hot weather.

Dacus ferrugineus, F., was again a major pest of several fruits [*cf.* **28** 2]. The percentages infested in guava orchards at Kohat ranged from 5-26 in August to 70 in September, but in pear orchards at Tarnab it was only 4–8 in September. Of the colour forms [*cf.* **28** 511], the one intermediate between the light and dark forms predominated in the field. The maximum number of eggs laid by one female in captivity was 213, within a period of 31 days. Experiments on bait-traps were continued. Of flies caught by baits of 1 part Clensel in 20 parts water or 8 oz. wheat bran and 8 oz. commercial borax in 1 gal. water, 50–60 per cent. were females, many of which contained eggs. Citronella oil at the rate of 1 drop to 1 oz. of sugar solution attracted many males, but few females. Fewer flies were attracted when the concentration of citronella oil was reduced (1 drop to 10 oz.), but they included proportionately more females.

Parasites of sugar-cane pests recorded during the year included *Ageniaspis pyrillae*, Mani, and *Cheiloneurus pyrillae*, Mani, from eggs of *Pyrilla* [**28** 510]; *Trichogramma intermedium*, How., from eggs of *Danaus* (*Danais*) *limniace*, Cram., *Diatraea* (*Argyria*) *sticticraspis*, Hmps., *Scirpophaga* spp., and *Emmalocera depressella*, Swinh., and recorded for the first time from India; *Mesostenoideus clavinervis*, Cam., and an undescribed species of *Rhaconotus* from larvae of *Scirpophaga* sp.; and *Phanerotoma hendecasiella*, Cam., from larvae of *E. depressella*.

The species of *Microbracon* parasitising larvae of *Antigastra catalaunalis*, Dup., in Delhi [**28** 512] has been diversely identified as *M. hebetor*, Say, and *M. brevicornis*, Wesm., and its identity is therefore being further investigated. At constant temperatures of 16 [60·8°F.], 25, 30 and 35°C., and at room temperature, the complete life-cycle lasted 35·4, 11·5, 7·5, 5·9 and 6·6 days.

A list is given of insects infesting crops, mostly in Delhi, with their natural enemies in a few cases.

Isaac (P. V.). **Report of the Second Entomologist (Dipterist) in Charge of Scheme for Research on Insect Pests of Sugarcane.**—*Sci. Rep. agric. Res. Inst. New Delhi 1938–39* pp. 134–135. Delhi, 1940.

The major pests of sugar-cane in India in 1938–39 included the moth-borers noticed in the previous report [*R.A.E.*, A **28** 3] and also *Diatraea auricilia*, Dudgn., in Pusa, and *D. venosata*, Wlk., and *Sesamia inferens*, Wlk., in Coimbatore. In New Delhi, the egg, larval and pupal stages of *S. uniformis*, Dudgn., lasted 5, 17–41 and 8–10 days, respectively, and adults survived for 5–7 days in May and June. Natural enemies of *Pyrilla* studied in the laboratory comprised *Dryinus* (*Lestodryinus*) *pyrillae*, Kieff., which parasitises the young nymphs, arresting their growth and causing them to become lethargic, *Ageniaspis pyrillae*, Mani, *Tetrastichus pyrillae*, Crwf., and *Cheiloneurus pyrillae*, Mani, which parasitise the eggs and appear during the crop season in the order given, and *Chrysopa* sp., which destroys the eggs and nymphs. Observations were also made on *Apanteles flavipes*, Cam., which parasitises *Diatraea venosata* and *Sesamia uniformis*, as well as *D.* (*Argyria*) *sticticraspis*, Hmps., and could be used to control all three. Mass liberations of *Trichogramma minutum*, Riley, for the control of *D. sticticraspis* were made in Orissa and Bihar.

Jack (R. W.). **The Tobacco Aphid.**—*Rhod. agric. J.* **37** no. 8 pp. 476–488, 1 pl., 1 fig., 8 refs., also *Bull. Minist. Agric.* [*S. Rhod.*] no. 1160, 15 pp., 1 pl., 1 fig., 8 refs. Salisbury, S. Rhod., 1940.

Data on the bionomics of *Myzus persicae*, Sulz., are reviewed from the literature, in view of its importance as a pest of tobacco and the vector of rosette disease in Southern Rhodesia [*cf. R.A.E.*, A **29** 84, etc.]. Its natural enemies there include a parasite of the genus *Lysiphlebus*, which is particularly effective during the winter; Coccinellids, such as *Cydonia* (*Chilomenes*) *lunata*, F.; and Syrphid larvae, of which *Xanthogramma* (*Ischiodon*) *aegyptium*, Wied., is a common species. The control measures advised by A. J. Smith for Virginia tobacco [**26** 177] are summarised and recommended for trial, though it is considered doubtful whether they can prevent the almost total infestation of maturing crops that has recently occurred in Southern Rhodesia, and particularly of Turkish tobacco late in the season.

Mossop (M. C.). **Control of Maize Weevil** (*Calandra oryzae*, **L.**).—*Rhod. agric. J.* **37** nos. 8 9 pp. 461–475, 517–528, also *Bull. Minist. Agric.* [*S. Rhod.*] no. 1161, 27 pp. Salisbury, S. Rhod., 1940.

In Southern Rhodesia, *Calandra oryzae*, L., attacks both standing and stored maize [*cf. R.A.E.*, A **26** 203, 608]. Attack in the field is heaviest near the chief sources of infestation, which include storage

sheds, shelling dumps, native compounds and railways. Moreover it is, in large part if not completely, confined to ears that allow access to the weevils, which do not chew through the sheath to reach the grains. The weevils probably develop in the field to some extent throughout the year, presumably in crop refuse when there is no standing crop. In any case, refuse already present can support weevils newly infesting the fields from outside sources such as shelling dumps. It is therefore recommended that land should be kept clear of crop refuse. Seed should be selected from the standing crop, and all ears that are injured in any way or that lack long, tight, unbroken sheaths should be rejected. Shelling dumps should be utilised or destroyed as early as possible, and shelling operations should be confined to the smallest possible areas. Cereal crops should not be grown near sources of infestation. Where ensilage is made from the whole plant, the maize growing nearest to sources of infestation should be used and the land should be ploughed and cleaned as early as possible.

Initial infestation of stored maize is due chiefly to weevils brought in with the maize from the fields and only partly to those from machinery, bags and other sources. Maize should be dried out thoroughly before being stored, and the store rooms should be kept clean, so that subsequent infestation is more easily noticeable. Bulk storage in iron, brick or concrete containers is increasing in popularity, but such grain should contain not more than 12·5 per cent. moisture. A tank filled with maize and hermetically sealed accumulates sufficient carbon dioxide to kill the weevils.

Storage in unprotected bags is inferior to bulk storage, but if used, the bags should be stacked as tightly as possible. Each bag, especially on the outside of the stack, should slightly overlap its neighbour at one end, and the overlap should be beaten tightly down. As most of the weevil damage in a tightly packed stack is confined to the peripheral bags, the stack should be built in the form of a cube. Investigations on this immunity of the inside bags from attack showed that the temperature was higher and the relative humidity lower in them than in the peripheral bags and that the grain in them was drier. There was no significant difference in carbon-dioxide content. Laboratory tests showed that the moisture content of maize depends largely on the relative humidity of the air surrounding it, and only slightly on normal temperatures. It can therefore be inferred that in a stack the total moisture present produces lower relative humidities when the stack warms up, and the maize consequently dries out. Since the peripheral bags lose heat and the relative humidity in them is therefore not reduced, the maize in them does not dry out to the same extent and the development of the weevil continues.

Preliminary experiments on the prevention of loss of heat from stacks have suggested a method of insulation which, however, has not yet been fully tested. The stack is built on dunnage of poles or sleepers, and bags of wood shavings or sawdust form the bottom and top layers. The sides are jacketed with quilts made of sacks containing wood shavings and sewn across in three places to form four compartments. These quilts are hung against the sides of the stack by means of hooks and overlap each other slightly. Tests have shown that peripheral bags protected in this way are little, if any, more infested than inside bags.

Appendices to this paper deal with the storage of seed maize, the construction of reinforced brick grain bins, and fumigation of grain.

MUNRO (J. W.). **Report on a Survey of the Infestation of Grain by Insects.**—Med. 8vo, viii+54 pp., 5 pls., 7 figs. London, Dep. Sci. Industr. Res., 1940. Price 1*s.* 3*d.* net (from H.M.S.O.).

This report is the result of a survey carried out in 1938 and 1939 in Great Britain of the nature, extent and sources of the infestation of stored grain by insects [*cf. R.A.E.*, A **27** 265], and reviews in detail the conditions existing in grain stores from the time imported grain arrives in the country until it has reached its final destination. Widespread investigations revealed the occurrence of infestation throughout all sections of industry producing, housing, transporting, manufacturing or using cereals and cereal products, no one section being entirely responsible for its general prevalence.

There was no evidence that grain weevils (*Calandra*) attack home-grown grain prior to or during harvesting, or even after storage in the rick and threshing, and home-grown grain becomes infested only during storage or transit through contact or proximity with infested material. Though there is an endemic population of grain insects persisting indoors throughout the country, imported grain is usually infested on arrival at the port. There is therefore both a resident and an imported insect population to be considered. The ability of the insects to maintain themselves in the grain is largely dependent on the interplay of temperature and humidity, which is not yet fully understood. The chief insects concerned and the types of material attacked by them are reviewed, a list is given showing the insects found in ships' cargoes of grain and other stored products from various parts of the world, and reference is made to the infestation of stored grain by mites, the importance of which is not fully realised in some sections of the industry.

The ways in which the grain becomes infested during transit, storage and processing are described, and emphasis is laid on the lack of sufficient cleanliness and segregation of goods at many stages in its progress. The advantages of modern methods of storage in silos, etc., are pointed out and the necessity for using clean uninfested sacks is stressed. Those made of paper are least liable to harbour insects.

The survey showed that the intensity and kind of infestation varies with the conditions of trading and with the conditions prevailing in grain stores. The first remedy is improved hygiene and cleanliness, followed by cool dry conditions of storage and the development of scientific methods in securing them. While a high degree of infestation continues in imported cereals and cereal products, hygienic methods alone will not control infestation ; the use of insecticides is most likely to give immediate results, but the choice of effective treatments is restricted, as they must not taint the grain or increase the risk of fire. Research on suitable insecticides is in progress. Many of the pests mentioned infest stored products generally, and the grain industry is justified in looking to other industries for co-operation in dealing with this important problem.

THOMAS (E. L.) & SHEPARD (H. H.). **The Influence of Temperature, Moisture, and Food upon the Development and Survival of the Saw-toothed Grain Beetle.**—*J. agric. Res.* **60** no. 9 pp. 605–615, 2 graphs, 16 refs. Washington, D.C., 1940.

The following is based on the authors' summary of investigations on the development of *Oryzaephilus surinamensis*, L., under various

conditions of temperature, atmospheric moisture and food : Rearings were made or attempted at temperatures of 15, 20, 25, 30, 35 and 40°C. [59, 68, 77, 86, 95 and 104°F.], at saturation deficiencies of 5, 12·5 and 22·5 mm., and with rolled oats, English walnuts and raisins as food. At 5 mm. saturation deficit and on rolled oats as food, the life-cycle from egg to adult averaged 69·06, 30·31, 20·67 and 18 days at 20, 25, 30 and 35°C. With rolled oats as food, the developmental optimum was at 35°C., while with walnuts, it occurs between 30 and 35°C. Eggs and larvae failed to develop at 15 or 40°C. In general, development was more rapid at the higher humidities. The egg and pupal stages appeared to be little affected by atmospheric moisture conditions. On the basis of the rate of development, rolled oats are a better food than walnuts or raisins. In experiments in which adults of *O. surinamensis* and *Tribolium confusum*, Duv., were exposed to high temperatures, and the former also to low ones, the period required for 50 per cent. mortality of *Tribolium* was a little over 4 hours at 44°C. [111·2°F.] and 30 per cent. relative humidity and about 40 minutes at 46°C. [114·8°F.] and 50 per cent. relative humidity. The corresponding periods for *O. surinamensis* were approximately 4·5 and 5·7 hours at 44°C. and relative humidities of 30 and 75 per cent., 34 hours at 42°C. [107·6°F.], 30 days at 10°C. [50°F.] and 105 hours at 2°C. [35·6°F.].

THORNE (G.). **The Hairworm** *Gordius robustus* **Leidy as a Parasite of the Mormon Cricket** (*Anabrus simplex* **Haldeman**).—*J. Wash. Acad. Sci.* **30** no. 5 pp. 219–231, 7 figs., 11 refs. 1940. (Abstr. in *Exp. Sta. Rec.* **83** no. 6 p. 797. Washington, D.C., 1940.)

Gordius robustus was first observed to be an important parasite of the mormon cricket, *Anabrus simplex*, Hald., in 1935 in the neighbourhood of Arrowrock Reservoir, Idaho, and as favourable breeding grounds for the Nematode occur in certain localities in this area along small mountain streams and in pools and swamps, it should be of economic importance when its host is not abnormally abundant. During the heavy outbreaks of *Anabrus* in 1935–37, however, the percentage parasitism was too low to be very effective, though in some cases it reached 25–50. Similar parasitism was also observed in Montana, where in certain small areas it amounted to 50–99 per cent. The parasitised insects rarely oviposit but live normally until the mature worms break through the abdominal wall to enter water or wet soil. Here the Nematodes mate and later hibernate in moist places under stones and rubbish ; eggs are laid in autumn but more generally in spring, when the overwintered females deposit them along the edges of streams, ponds or swampy areas. The young larvae are probably picked up by young nymphs while feeding. On reaching the intestine they bore through the wall and enter the body cavity, remaining there until mature. Under present erosion conditions in breeding areas of *G. robustus*, most of them are carried away by floods.

SNELLING (R. O.), BLANCHARD (R. A.) & BIGGER (J. H.). **Resistance of Corn Strains to the Leaf Aphid,** *Aphis maidis* **Fitch.**—*J. Amer. Soc. Agron.* **32** no. 5 pp. 371–381, 1 fig., 31 refs. 1940. (Abstr. in *Exp. Sta. Rec.* **83** no. 6 p. 798. Washington, D.C., 1940.)

Investigations on the infestation of maize by *Aphis maidis*, Fitch, indicate that it may be possible to reduce injury by the use of resistant

strains. The prevention of such injury is of special importance in the development of certain foundation seed stocks used in the production of commercial hybrid seed maize. Infestation was determined by examination of recently emerged tassels for the presence of Aphids. Data obtained from many yellow and white inbred lines, as well as from a number of single crosses, indicate that resistance to the Aphid is a hereditary character.

Simpson (G. W.). **Aphids and their Relation to the Field Transmission of Potato Virus Diseases in northeastern Maine.**—*Bull. Maine agric. Exp. Sta.* no. 403 pp. 189–305, 6 graphs, 44 refs. Orono, Me., 1940.

A detailed account is given of investigations from 1931 to 1938 in Aroostook County, north-eastern Maine, on the part played by Aphids in the dissemination of virus diseases of potato, with a view to determining methods of protecting the foundation seed stocks of the variety Green Mountain, which is extensively grown there and in which *Solanum* virus 1 is latent. The disease of importance is mild mosaic, which is due to the transmission by Aphids of *Solanum* virus 3 to plants harbouring *Solanum* virus 1. Leaf roll, which is caused by *Solanum* virus 14, is important only in certain seasons. The principal sources of infection of healthy potato stalks are plants growing from infected seed pieces in the seed plot and diseased plants in fields in the vicinity. The Aphids that commonly occur on potato in the county are the foxglove Aphid, *Macrosiphum solani*, Kalt. (*Myzus pseudosolani*, Theo.), the pink and green potato Aphid, *M. solanifolii*, Ashm., the buckthorn Aphid, for which the author uses the name *Aphis abbreviata*, Patch, since doubt has been thrown on the identity of *A. rhamni*, Boy., of which it is usually considered a synonym, and the green peach Aphid, *Myzus persicae*, Sulz. Of these, the principal vector of *Solanum* virus 3 is *M. persicae*; it is also transmitted by *Macrosiphum solanifolii* and *A. abbreviata* and possibly by *M. solani*, which is a known vector of *Solanum* virus 14. *M. solani* is comparatively scarce in Aroostook County, probably because its winter food-plant, *Digitalis purpurea*, is rather rare and occurs only in restricted localities. *M. solanifolii* is widely distributed, as its winter food-plants, wild and cultivated roses, are abundant. *A. abbreviata* has been found in large numbers on potatoes growing near its winter food-plants, *Rhamnus alnifolia* and *R. cathartica*, of which the former occurs in low areas flooded at certain times of the year. The only known winter food-plant of *Myzus persicae* in Aroostook County is the wild plum, *Prunus nigra*, which is not especially abundant, but it may also overwinter on house plants or in greenhouses. It is common throughout the county by the end of the season. It migrates to potato seed plots somewhat later than the other Aphids and usually remains until the plants are killed by frost or die naturally; it increases rapidly in seasons with abnormally hot weather. A numerical study of the Aphid population on experimental plots indicated that *M. persicae* was much more abundant in years in which the greatest spread of the virus occurred.

Observations on the effect of the date of planting showed that seed plots planted early (in May) are usually infested by Aphids before plots planted late (in June). Infestation of the former is almost invariably initiated by winged migrants before the middle of July,

while potatoes planted in June become infested after mid-July and sometimes not until August, and mainly by winged dispersal forms, most of which come from potato, which is the most numerous of their summer food-plants. In the experimental plots, a marked increase in the number of diseased tubers present in a rogued seed stock occurred only in late planted plots or in years in which *Myzus persicae* was numerous and was associated with the early maturity of diseased plants in nearby fields and with an increase in the numbers of winged Aphids in the plots, especially during August.

The course of infestation and its relation to the spread of virus diseases in various seasons between 1931 and 1938 in seed plots established at 7 centres in the county are described and discussed. Two of these centres were found to be satisfactory in most seasons for the propagation of foundation seed stock, but in no case studied was the isolation of the plot sufficient in all years to prevent the spread of virus disease from field to field. It appeared that, in the absence of a natural barrier, a distance of less than a mile did not afford adequate isolation. The author considers, however, that seed stocks may be propagated indefinitely in Aroostook County, provided that they are planted in a situation so isolated that field-to-field spread of the virus is prevented. Seed should be planted before 20th May, since early planting enables infected plants to be removed before Aphids are numerous and harvesting to be completed by mid-August, which is usually early enough to avoid considerable late-season spread of virus.

The plots should be inspected at frequent intervals during July and August and plants showing evidence of infection removed.

KNIGHT (P.). **The Problems of Insect Study.**—2nd Edn., $10\frac{3}{4} \times 8\frac{1}{4}$ ins., vii+132 pp., 22 pls., 31 figs., multigraphed, 2 pp. refs. Ann Arbor, Mich., Edwards Brothers, Inc., 1939. Price $2·50. [Recd. 1941.]

In recent years, general interest in the work of entomologists has increased considerably in the United States, and this book, the scope of which was suggested by questions of students of widely differing interests in an introductory course in entomology, is intended for that section of the public desiring general information on the science and problems of entomology, and gives precedence to its social, economic and broadly biological aspects rather than to specific insects.

After stating the conditions that have brought insects into close relationship with man, the author gives general but extremely comprehensive accounts of the ways in which they are harmful and of use to man, and shows how they are favoured by their structure, physiology and behaviour. Other sections deal with classification, anatomy, physiology, behaviour and development, and in a concluding section the agricultural practices and other factors that promote the continuance of insects as pests, the organisation of their control and measures employed against them are reviewed.

BURKS (B. D.). **Revision of the Chalcid-Flies of the Tribe Chalcidini in America north of Mexico.**—*Proc. U.S. nat. Mus.* **88** no. 3082 pp. 237–354, 14 figs., 18 refs. Washington, D.C., 1940.

This paper comprises keys to the genera and species and descriptions of the latter, with records of their hosts and distribution. The new

species include *Spilochalcis leptis*, which parasitises *Zelleria haimbachi*, Busck, *Ancylis comptana*, Froel., *Spilonota* (*Tmetocera*) *ocellana*, Schiff., and *Tortrix* (*Cacoecia*) *argyrospila*, Wlk., and was taken in California, Colorado, Nevada, Idaho, Arizona, Iowa, Kansas, Missouri, Montana, Utah and Texas. The author finds that *Spilochalcis vittata*, Ashm., is a synonym of *S. igneoides*, Kby., *S. torvina*, Cress., of *S. side*, Wlk., and *S. delira*, Cress., of *S. flavopicta*, Cress., but several records of *delira* in the literature [*R.A.E.*, A **3** 684 ; **5** 449 ; **9** 312 ; **17** 345 ; **22** 644] are misidentifications and refer to *S. side*.

COPENHAFER (L. M.) & PARKER (R. L.). *Ornix prunivorella* **Chambers (Lepidoptera, Tineidae), a Pest of the Apple Tree in the Lower Missouri River Valley Region.**—*J. Kans. ent. Soc.* **11** no. 2 pp. 37–53, 28 figs., 19 refs. Manhattan, Kans., 1938. [Recd. 1941.]

An account is given of investigations on the bionomics and control of *Parornix* (*Ornix*) *prunivorella*, Chamb., on apple in Kansas, where it was first recorded in 1933 and caused serious damage in 1937. Although apple is the favourite food-plant of this Tineid, it also heavily infested all varieties of quince and pear and attacked sour cherry (*Prunus cerasus*) and seedling cherry stock (*P. mahaleb*) but not sweet cherry (*P. avium*) or cultivated plum. The eggs are laid singly on the lower surface of the leaf and the larvae mine below the epidermis, which dies and turns brown. The larva leaves the mine to pupate, and spins its cocoon either on the same leaf or on another near at hand. During mid-summer, the larval life in the mine lasts about 10–14 days. Both the larvae and the pupae overwinter. In 1933, the duration of the life-cycle ranged from 18 to 35 and averaged 27 days, and adults of eight successive generations were observed between early April and mid-October. The large number of generations was undoubtedly due to the warm rains in the autumn, since infested apple leaves were collected in the field as late as 19th December. As many as 90–95 per cent. of the leaves of apple may be infested, and the number of mines per leaf was as high as 9.

The injury caused is increased, and the problem of control complicated, by the fact that arsenicals applied during periods of high temperature and low humidity scorch the leaves in the region of the larval mines. In the autumn of 1933, leaves from apple trees that had been used for tests of various spray programmes against *Cydia* (*Carpocapsa*) *pomonella*, L., were examined ; the percentages infested by *Parornix* and the numbers and percentages scorched at the mines are shown in tables. In addition to arsenicals, the stomach poisons included barium fluosilicate and cryolite, which were applied after 3 cover sprays of lead arsenate. The tables show that spray injury was somewhat reduced and control of *Parornix* improved when sprays of 1 pint nicotine sulphate or oleic acid in 1 gal. summer oil emulsion (Verdol) or 1 pint nicotine sulphate and 3 pints tannic acid, all in 100 gals. water, were used instead of stomach poisons in the last 4 of 8 sprays. The best control was afforded by the programme including nicotine sulphate and oil emulsion, which gave average leaf infestations of 0·05–0·12 per cent. and 1·28–12·66 per cent. of leaf mines not scorched.

Parasites bred from *P. prunivorella* comprised *Elasmus albicoxa*, How., *Zagrammosoma multilineata*, Ashm., *Cirrospilus nigrovariegatus*,

Gir., *Sympiesis bimaculata*, Crwf., *Catolaccus aeneoviridis*, Gir., *Horismenus fraternus*, Fitch, *Tetrastichus coerulescens*, Ashm., *Apanteles tischeriae*, Vier., and *Xenosternum ornigis*, Mues. Larvae and pupae on fallen leaves can be destroyed by disking or cultivating the ground during autumn and winter and burning the leaves.

Worthley (H. N.) & Steiner (H. M.). **Experimental Spraying to control European Red Mite** (*Paratetranychus pilosus* **C. & F.**) **and Rosy Apple Aphid** (*Anuraphis roseus* **Baker**) **in 1939.**—*Bull. Pa agric. Exp. Sta.* no. 390, 10 pp., 2 figs. State College, Pa., 1940.

Experiments in Pennsylvania on the use of dormant and delayed-dormant sprays against eggs of *Anuraphis roseus*, Baker, and *Paratetranychus pilosus*, C. & F., on apple were continued in 1939 [*cf. R.A.E.*, A **27** 535]. The composition of the various sprays and the results are shown in tables. Of the dormant sprays, which were applied on 23rd March, the one most effective against the eggs of the mite (10·1 per cent. hatch as compared with 87·6 per cent. on control trees) was 4 per cent. lubricating oil emulsified in the tank with 0·5 lb. goulac [sulphite lye] per 100 U.S. gals. spray, but it did not reduce the Aphid populations below those on the controls (8·3 per cent. rosetted spurs in June). The addition to the spray of 3·6 per cent. low-temperature tar-oil emulsion (2½ per cent. actual oil) considerably increased the kill of Aphid eggs (1·8 per cent. rosetted spurs in June) and interfered little with mite control (16·7 per cent. hatch), but an equal amount of high-temperature tar oil significantly reduced the kill of mite eggs. Both caused slight scorching of the first green leaves. Petroleum oil containing 2 and 4 per cent. DN [dinitro-ortho-cyclohexylphenol] and used at concentrations of 3 and 2·25 per cent. with the addition of 1 and 1·75 per cent. lubricating oil, respectively, resulted in 12·2 and 12·5 per cent. hatch of mite eggs and 1·1 and 2·6 per cent. rosetted spurs. The corresponding percentages for the stronger dinitro spray without lubricating oil were 18·6 and 1·6.

The trees used as controls for the delayed-dormant sprays showed 88·2 per cent. hatch of eggs of the mite and 5·3 per cent. rosetted spurs in June. These sprays were applied in mid-April, and the best control of the mite (13·9 per cent. hatch) was given by 3 per cent. lubricating oil, emulsified with goulac, to which was added 0·5 per cent. low-temperature tar oil and 1·3 per cent. liquid lime-sulphur ; it reduced injury by the Aphid to 0·2 per cent. rosetted spurs, but its real effect was difficult to judge as the infestation was light. The injury to the opening buds was comparable to that sometimes caused by winter-strength lime-sulphur, but was rapidly outgrown. Good results were also obtained when 3 per cent. lubricating oil was emulsified with Bordeaux mixture (2–6–100), particularly when nicotine sulphate was added ; the mixed spray resulted in 14·5 per cent. hatch of mite eggs and 0·1 per cent. rosetted spurs. The effectiveness of the oil was reduced by a stronger Bordeaux mixture.

Since it may not be possible to spray the whole of an orchard in either the dormant or the delayed-dormant stage, a combined programme is suggested, and detailed directions are given for mixing and applying a schedule of economical and effective tank-mixed sprays.

Wood (M.). **The Rose Leaf Beetle in Pennsylvania.**—*Bull. Pa agric, Exp. Sta.* no. 387, 22 pp., 7 figs., 3 pp. refs. State College, Pa., 1940.

An account is given of investigations in 1936–1939 on the bionomics and control of *Nodonota puncticollis*, Say, in southern Pennsylvania [*cf. R.A.E.*, A **26** 287]. The synonymy and distribution of this Eumolpid are discussed, and all stages are briefly described.

The emergence of adults from the soil began in the last 10 days of May, reached a peak during the first 10 days of June and ceased during the second half of the month ; most of the adults had disappeared by the end of July. Oviposition apparently begins in early June ; the eggs are laid in small clusters under particles of soil and hatched in an average of 10·7 days in the laboratory. Larvae were found in the soil in late June and were plentiful until May of the following year ; they were most common in areas supporting a wide variety of plants and occurred among roots of cinquefoil [*Potentilla*], hawkweed [*Hieracium*] and occasionally wild strawberry. They pupated in May and June in bare earthen cells less than an inch below the soil surface, and the pupal stage averaged 15 days. Natural enemies included Asilid larvae of the genus *Promachus*, which were predacious on the larvae, and the Nematode, *Diplogaster aerivora*, which parasitised the pupae.

The adults are polyphagous, and a list of their food-plants, based partly on the literature, is given, showing the degree of injury caused to flowers, fruit and foliage. Preferred food-plants include apple, plum, peach and pear. The injury to the fruit consists in small shallow pits where the skin or outer flesh has been eaten, but in some fruits, principally apples and peaches, the pits are quite deep. The main damage to fruits occurred in the first fortnight of June. Damage to apple fruits was most severe in unsprayed and poorly sprayed orchards, and experiments are described indicating that sufficient protection is given by spraying with lead arsenate (3 lb. per 100 U.S. gals. spray) just before the adults begin their attack at the end of May and again a fortnight later if they are abundant [*cf.* **28** 344].

Webb jr. (J. E.) & Alden (C. H.). **Biological Control of the Codling Moth and the Oriental Fruit Moth.**—*J. econ. Ent.* **33** no. 3 pp. 431–435, 2 figs. Menasha, Wis., 1940.

An account is given of the methods used in Georgia during 1930–39 for the rearing of *Trichogramma minutum*, Riley, for the control of eggs of *Cydia* (*Carpocapsa*) *pomonella*, L., on apple and *C.* (*Grapholitha*) *molesta*, Busck, on peach, of its laboratory host, *Sitotroga cerealella*, Ol. [*cf. R.A.E.*, A **25** 470], and of *Macrocentrus ancylivorus*, Rohw., on *Ancylis comptana*, Froel., for the control of the larvae of *C. molesta*. The apparatus used for breeding and transporting the insects is described. In 1929 39, more than 310 millions of *Trichogramma* were colonised for the control of *C. pomonella* and *C. molesta* and more than 19 millions for the control of pests of pecan, cotton and vegetables. Of 37,057 eggs of *C. pomonella* and 2,101 of *C. molesta* collected in 1930 39, 56·2 and 36·3 per cent. were parasitised by *T. minutum*, the highest percentage parasitism in any one year being 77·6 for *C. pomonella* in 1932 [*loc. cit.*] and 47·3 for *C. molesta* in 1930. Infestation of peach fruits decreased almost continuously from 23·9 per cent. in

1932 to 0·3 per cent. in 1939 in an orchard in which *T. minutum* was colonised every year and one or more colonies of *M. ancylivorus* were liberated, and observations in three orchards showed that *T. minutum* is particularly effective against eggs of the later generations of *C. molesta*.

Habrocytus cerealella, Ashm., occasionally parasitised *S. cerealella* in the laboratory, but never reached destructive proportions until the end of the season. Outbreaks of this Pteromalid are controlled by fumigating the whole laboratory with hydrocyanic acid gas for at least 48 hours, after removing the stock of *T. minutum* and some of the cabinets in which *Sitotroga* is breeding. New cabinets are stocked with eggs of *Sitotroga* that have been dipped in carbon bisulphide, which kills any larvae or mites but does not reduce the fertility of the eggs, and isolated from both the other breeding cabinets and the laboratory until this has been thoroughly cleaned and left empty for at least a month.

About 40,000 adults of *M. ancylivorus* have been colonised throughout the State. Most of them were bred and collected in a room that is black inside except for one wall, which is white and attracts the moths and adult parasites, but several thousand were produced in an outdoor cage in 1938–39. The parasites were obtained from *A. comptana* collected in New Jersey. During 1930–39, 3,450 twigs infested with *C. molesta* were collected from orchards in which *M. ancylivorus* had been colonised, and from these, 1,340 total emergences were obtained, of which 385 (28·7 per cent.) were *M. ancylivorus*. In addition, 11 adults of other parasites were obtained, making the total average of larval parasitism 29·6 per cent. The highest percentage parasitism for any one collection was 100 in 1930, and the highest for any one year 80·2 in 1937.

During 1936–39, an average of 19·1 per cent. of 2,593 larvae of the first, second and third generations of *C. pomonella* were parasitised. *Ascogaster carpocapsae*, Vier., and its hyperparasite, *Perilampus* sp., represented nearly 71 and 24 per cent. of the parasites recovered; the other parasites were *Pristomeridia* (*Pristomerus*) *agilis*, Cress., *Phanerotoma tibialis*, Hald., and *Ephialtes* (*Calliephialtes*) *grapholithae*, Cress. [*cf.* **26** 30].

STEINER (L. F.). **Codling Moth Flight Habits and their Influence on Results of Experiments.**—*J. econ. Ent.* **33** no. 3 pp. 436–440, 3 refs. Menasha, Wis., 1940.

Little definite evidence has been available on the effect of inter-tree or inter-plot movement of adults of the codling moth [*Cydia pomonella*, L.] on the results of control experiments. Data on their flight habits obtained during investigations in southern Indiana in 1934–38 are summarised and show that extensive inter-tree and inter-plot movement is common. About 10,000 newly emerged adults were marked and liberated in or near areas in which bait traps were being used. Most of the baited areas were 10–15 acres in extent, though additional scattered traps were generally placed in other parts of the same orchards. The moths travelled an average of 200 ft. from their points of release in baited areas, where the recorded flights were limited by the distance to the outer traps and the termination of flight by capture, and would probably normally move a greater distance from the point of emergence. Normal migration for 200 ft. would be equivalent to a mass migration

of all moths from the centre to the outside of a 3-acre plot. Individual flights of more than 2,000 ft. were recorded, indicating that a moth can fly to all parts of a square 100-acre orchard before completing oviposition.

When there are two generations in the year, the results of insecticide tests may be affected by normal migration if plots of 3 acres or less are used, while if there is a third generation, the influence of migration may be extended further. With smaller plots, the replication of treatments will not eliminate this influence; plots containing ten trees appear to be no more effective than those containing only one. Consequently, if the fruit is not examined until it drops or is harvested, small-plot tests in an area where two or three generations occur in the year may show the relative effectiveness of the treatments against only the latest brood. Migration of moths late in the season obscured to a considerable extent the effectiveness of orchard sanitation and banding or the use of bait traps in tests involving 20-acre and 12-acre plots, respectively. The rapid increase of population in the treated areas late in the season, largely as a result of moth movement, more than compensated for the control obtained early in the season.

The evidence suggests that there is a normal levelling of the population between areas of light and heavy infestation, though movement occurs in both directions, that some moths make long flights, and that under favourable conditions some of the population may extend its normal movement to considerable distances, giving the effect of a mass migration.

GINSBURG (J. M.). **Replacing Cresylic Acid with Tar Oil in the Delayed Dormant Spray on Apple Trees.**—*J. econ. Ent.* **33** no. 3 pp. 440–443, 3 refs. Menasha, Wis., 1940.

Although a dormant spray containing 2·5 per cent. tar oil has been shown to be superior to a delayed-dormant spray containing 0·5 per cent. cresylic acid for the control of Aphids on apple in New Jersey [*R.A.E.*, A **26** 738], many growers continue to use delayed-dormant sprays for various reasons, and investigations were therefore carried out in 1938 and 1939 to determine the concentration of tar oil, which is cheaper and readily emulsified, that should be added to 3 per cent. petroleum oil in place of cresylic acid to kill the Aphid eggs in the delayed-dormant stage without injuring the buds. No distinction was made in the tests between *Rhopalosiphum prunifoliae*, Fitch, *Aphis pomi*, DeG., and *Anuraphis roseus*, Baker. The cresylic acid used was a partly water-miscible proprietary product containing about 95 per cent. tar acids, and the tar oil was a commercial emulsion containing about 83 per cent. high-boiling coal-tar distillates. In 1938, the percentages of spurs free from Aphids were 98 for 0·5 per cent. cresylic acid, 99 and 99·5 for 1 and 2 per cent. tar oil, and 34·2 on unsprayed trees, while in 1939 they were 96 for the cresylic acid and 91 and 97·8 for 0·5 and 0·66 per cent. tar oil, as compared with 100 for 2·5 per cent. tar oil in a dormant spray. The eggs of *A. roseus* appeared to be rather more resistant to the delayed-dormant sprays than those of the other Aphids. Delayed-dormant sprays containing 1 per cent. tar oil or more retarded the development of fruit buds in general and severely injured many lateral buds, but injury due to tar oil at 0·66 per cent. was no worse than that usually caused by cresylic

acid. The addition of tar oil at the delayed-dormant stage did not interfere with the efficiency of the petroleum oil in the control of *Paratetranychus pilosus*, C. & F.

CUTRIGHT (C. R.). **Technique in Control Experiments with Apple Aphids.**—*J. econ. Ent.* **33** no. 3 pp. 443–445, 2 figs. Menasha, Wis., 1940.

The author describes a technique developed in Ohio for experiments with sprays against *Rhopalosiphum prunifoliae*, Fitch, *Anuraphis roseus*, Baker, and *Aphis pomi*, DeG., on apple. For tests against the eggs, sections of apple twigs 2–3 ins. long are used. The eggs on them are counted, and sufficient twigs bearing not less than 4 normal eggs are fixed in an upright position on cards to provide 75–100 eggs per card. The cards are kept out-of-doors or in a cold insectary and four are used for each treatment. The ovicides are applied with a hand or small electric sprayer while similar sprays are being used in the orchard, and a strip of adhesive is placed round the edges of the cards when they are dry. When the eggs hatch, the young stem mothers are caught on the strip, where they are easily counted. The rate and time of hatching are determined by daily counts on one or more cards, and the percentage of eggs hatching by a final count on all four cards. The same technique is effective with eggs of the European red mite [*Paratetranychus pilosus*, C. & F.] and the apple leaf roller [*Tortrix argyrospila*, Wlk.]. In the field tests, 6–9 replicates of single tree plots are used, and records are obtained 4–8 weeks after spraying by determining the rate and degree of infestation of a given number of terminals per tree.

The method developed for testing insecticides against active Aphids has been used only in the case of *A. pomi*. *Anuraphis roseus* is unsuitable because it hides in curled foliage, and *R. prunifoliae* because it migrates early. Four or more one-tree plots are required for each material to be tested. Several terminals are cut from each tree before it is sprayed, and these are placed in water in the laboratory. Each twig is sprayed by revolving it slowly at a distance of about 5 ft. from the spray gun and then placed out-of-doors. Counts of the living and dead Aphids on all the twigs from each tree are made at the end of 24 and 48 hours. In the field test, the entire tree is thoroughly sprayed after a number of terminals have been marked with the estimated population of Aphids as a check against the possible loss of Aphids by dropping after spraying. Several of the marked terminals are cut off 24 or 48 hours after spraying, placed in individual paper bags and removed to the laboratory for examination. A combination of the data from the laboratory and field tests gives an adequate picture of the performance of the material.

COX (J. A.). **Comstock's Mealybug on Apple and Catalpa.**—*J. econ. Ent.* **33** no. 3 pp. 445–447, 3 refs. Menasha, Wis., 1940.

Pseudococcus comstocki, Kuw., has been known as a pest of *Catalpa* in Virginia since 1923 and was first found to be causing damage to apple there in 1934 [*R.A.E.*, A **24** 722]. It caused serious damage in some orchards in 1937 and 1939, and is now present in many of the apple-growing regions of the State. In 1939, infestation by it was more severe in commercial orchards that had been thoroughly

sprayed and had received annual applications of nitrogenous fertilisers than in those that received not more than two arsenical sprays and no fertiliser.

Parasites bred from *P. comstocki* in 1939 comprised the Pteromalid, *Pachyneuron altiscuta*, How., a Calliceratid of the genus *Lygocerus* and the Encyrtids, *Thysanus niger*, Ashm., *T. elongatus*, Gir., and *Clausenia purpurea*, Ishii, which was the most important of all. Data obtained from apple orchards indicate that the percentage parasitism by *C. purpurea* is low during the first generation of *P. comstocki* and gradually increases during the development of the second and third generations; the highest recorded was 70 per cent. parasitism of the third generation. The percentage parasitism of this generation on *Catalpa* in one locality was 94. An undetermined fungus destroyed a large number of the mealybugs on certain *Catalpa* trees, but few of those on apple were attacked by it, probably because a fungicide had been applied.

HAMILTON (D. W.). **Spray Residue and Substitutes for Lead Arsenate in Control of Cherry Fruitflies.**—*J. econ. Ent.* **33** no. 3 pp. 447–451, 2 figs., 3 refs. Menasha, Wis., 1940.

The following is based on the author's summary of investigations in New York State in 1937–39 on the use of sprays to kill adults of *Rhagoletis cingulata*, Lw., and *R. fausta*, O. S., on cherry during the preoviposition period [*cf. R.A.E.*, A **26** 489]: Lead arsenate has been used effectively to control cherry fruit-flies, but residues have been above the tolerances at harvest. Analyses of cherries show that when lead arsenate is used at the rate of 2½ lb. per 100 U.S. gals. spray at sepal-fall, the use of arsenicals in the maggot sprays [those applied during the preoviposition period] will create excessive residues. Where danger of arsenical injury prevents the use of more than 1 lb. lead arsenate per 100 U.S. gals. at sepal-fall, 1 lb. basic zinc arsenate may be applied in the first maggot spray. Field experiments were carried out with cubé root and phenothiazine [thiodiphenylamine] as possible substitutes for arsenicals for the control of cherry fruit-flies. Because of the habits of the flies, it was necessary to spray large blocks of big plantings or use isolated plantings for the tests. Since cubé and phenothiazine weather rapidly, their application was closely timed according to the species of fruit-flies present and the time of their emergence. A satisfactory method for making infestation records, which consisted of rearing out all maggots from certain trees, was developed.

Both cubé and phenothiazine reduced heavy populations of fruit-flies satisfactorily when at least three applications were made at the rate of 2 lb. per 100 U.S. gals. In one test, a 15 per cent. phenothiazine dust appeared to be nearly as effective as these sprays. Basic zinc arsenate only partly controlled cherry fruit-flies when two light applications were made.

CHANDLER (S. C.). **Control of Plum Curculio on Peach in Illinois.**—*J. econ. Ent.* **33** no. 3 pp. 451–453, 1 fig. Menasha, Wis., 1940.

In 1939, 2–4 applications of sprays containing 3 lb. lead arsenate per 100 U.S. gals. with zinc sulphate and lime, applied for the control of *Conotrachelus nenuphar*, Hbst., on peach in Illinois at the rate of about

3 U.S. gals. per mature tree, caused nearly three times as much leaf drop as the same number of arsenical oil dusts (containing 10 per cent. lead arsenate and 5 per cent. oil) applied at the rate of $\frac{3}{4}$ oz. per tree, and nearly four times as much as that from untreated trees, but excessive numbers of dust applications (5–10) caused severe damage. Over a period of eight years, there was practically no difference in the control of *C. nenuphar* by the dust and the spray [*cf. R.A.E.*, A **28** 20].

Synthetic cryolite (4 lb. per 100 U.S. gals.) caused injury to the fruit and foliage for the first time in Illinois in 1939 [*cf. loc. cit.*]. Both the degree of control and the injury were very variable, but the average control was inferior to that given by lead arsenate, and it is concluded that cryolite is an unreliable and sometimes dangerous substitute for it.

Jarring carried out over several years early in the season has shown that the numbers of weevils are considerably greater at the edges of peach orchards than a few rows in. Of two orchards in which dusting was carried out in 1938 in accordance with the results of jarring, one was dusted only once over the entire area and three times over the outer four rows and the other was dusted twice over the outer rows only ; in both cases, infestation at harvest was lower in the middle of the orchard than at the edges, and satisfactory control was obtained with considerable saving of materials. Jarring in 1939 at weekly intervals from petal-fall to harvest in one orchard that received 3 sprays showed that there were never as many weevils in the fifth row from the edge as in the first, which was next to a wood, the ratio for the entire season being 1 : 3. The procedure recommended for economy, efficiency and safety to fruit and foliage, therefore, is a minimum number of applications of oil dust over the entire orchard with additional ones at the edges or where jarring indicates abundance.

Snapp (O. I.). **Further Studies of the Plum Curculio in the Georgia Peach Belt.**—*J. econ. Ent.* **33** no. 3 pp. 453–456, 2 refs. Menasha, Wis., 1940.

As there is usually a large second generation of the plum curculio [*Conotrachelus nenuphar*, Hbst.] on peach in central Georgia, studies were conducted during 1936–39 on certain aspects of the biology of the weevil, particularly on the oviposition of females of the first generation. Observations on isolated pairs showed that approximately 50–75 per cent. of the females of the first generation deposited eggs during the year of their emergence and that very few of those that did not contained eggs at the end of the season. Many of the females that had oviposited entered hibernation. Both overwintered females and those of the first generation were present for about a month before ovipositing.

Tests showed that the movement of adults of the first generation after their emergence from the soil was confined mainly to the tree from which they came and to neighbouring trees. After emerging from hibernation, however, adults travelled from tree to tree even if there was fruit for food and oviposition, but when they had dispersed through the orchard, their movements appeared to be confined to a few adjacent trees. Neither first- nor second-generation adults appeared to migrate from orchards in which the peaches had been harvested to others in which they had not. The generally accepted view that the weevils hibernate among fallen leaves, etc., at the edges

of woods close to peach orchards was confirmed during the winter of 1937–38, and on 4th August 1938 adults were collected from débris along a right-of-way adjoining an orchard, indicating that they had begun to enter hibernation within a month of the peach harvest. In five of seven years, the overwintered weevils appeared on the peach trees before they were in full bloom, and in six of these years they were disseminated throughout the orchards by the time that 75 per cent. of the petals had fallen. In years in which they appear before petal fall, an application of lead arsenate at that time kills many before they oviposit and before the fruits are exposed.

FLETCHER (R. K.). **Certain Host Plants of the Cotton Flea Hopper.**—*J. econ. Ent.* **33** no. 3 pp. 456–459, 4 refs. Menasha, Wis., 1940.

In Texas, the preferred food-plants of the cotton flea-hopper, *Psallus seriatus*, Reut., from early spring until frost and those on which most of its winter eggs are laid are weeds of the genus *Croton*, of which the commonest is *C. capitatus* [*cf. R.A.E.*, A **21** 655; **27** 245, etc.], and factors that determine the abundance of *Croton* spp. therefore indirectly influence the abundance of the Capsid. Agriculture is the chief of these factors. Records are given for the years 1934–39 of the variation in abundance and in average height of plants of *C. capitatus* in fields of seven classes varying in character from those that had lain fallow during the previous crop-growing season, in which *Croton* was abundant, to freshly cleared woodland in which there was none. In the region under study, cotton is frequently cultivated until the third week in August and nearly all weeds are destroyed, but maize is rarely cultivated after the first week of June. Maize fields therefore offer good conditions for *Croton*, which develops as late as October.

Of the other weeds that appear in freshly disturbed soil, *Oenothera laciniata*, *O. speciosa* and *Monarda* spp. are also important in building up populations of *P. seriatus*. An early spring generation is able to develop on *O. laciniata*, which is often present some time before *Croton*. All these food-plants are indigenous to Texas and have increased in abundance owing to the destruction of the original vegetation, in which grass was dominant, with a consequent increase in the incidence of *P. seriatus*.

SCHWARDT (H. H.) & LINCOLN (C. G.). **Soil Fumigation for Control of the Alfalfa Snout Beetle.**—*J. econ. Ent.* **33** no. 3 pp. 460–462, 2 refs. Menasha, Wis., 1940.

The area in the United States over which lucerne is infested by *Otiorrhynchus* (*Brachyrrhinus*) *ligustici*, L. [*cf. R.A.E.*, A **23** 465, 557; **25** 179] is at present about 3,000 acres in New York on the eastern shore of Lake Ontario and is increasing annually, though very slowly, since the weevils cannot fly. Small isolated infestations sometimes occur several miles from the continuously infested area, and, in order to limit the spread of the weevil, attempts were begun to develop a system of soil fumigation that would eradicate them. This would be possible only in late summer and early autumn, when both larvae and adults are in the soil and the soil temperature is still at summer level. Experiments in September and October 1939 with orthodichlorobenzene, carbon tetrachloride, dichloroethyl ether,

methyl bromide, carbon bisulphide and chloropicrin indicated that carbon bisulphide was the only fumigant that could be relied on to give complete mortality of both stages under the various weather and soil conditions encountered in northern New York. Orthodichlorobenzene was the only fumigant that caused immediate noticeable damage to the lucerne. A dosage of 3,540 lb. carbon bisulphide per acre injected in holes 15 ins. apart and 8 ins. deep gave complete mortality in all tests, and one of nearly 1,800 lb. per acre caused almost complete mortality. It is concluded that a dosage of 2,500 lb. per acre would probably be completely effective. In addition to cost of material, about 40 man-days are required to treat an acre.

Wylie (W. D.) & Palm (C. E.). **A Method for Production of Cutworms in Greenhouses.**—*J. econ. Ent.* **33** no. 3 pp. 462–463, 1 ref. Menasha, Wis., 1940.

An account is given of laboratory methods used for breeding *Cirphis* (*Leucania*) *unipuncta*, Haw., *Agrotis ypsilon*, Hfn., and *Amathes* (*Graphiphora*) *c-nigrum*, L., in order to secure numerous uniform larvae for insecticide tests.

Bare (C. O.). **Commercial Control of Cabbage Caterpillars near Charleston, S. C.**—*J. econ. Ent.* **33** no. 3 pp. 463–467, 2 refs. Menasha, Wis., 1940.

The following is based on the author's summary: As part of a detailed survey of the populations of caterpillars attacking cabbage in fields near Charleston, South Carolina, during 1935–38, a study was made of the control methods used by commercial growers and their effectiveness. Eleven fields were under observation during the autumn growing season, and eight during the winter-spring season. Weekly examinations were made of 200 plants in each field from the time of thinning or transplanting until harvest was completed, and records were kept of insecticide applications, harvest yields, and larval and pupal populations of *Plutella maculipennis*, Curt., *Plusia* (*Autographa*) *brassicae*, Riley, *Pieris rapae*, L., cutworms and related species, including *Heliothis armigera*, Hb., and *Hellula undalis*, F.

Although insecticides were applied at regular intervals by a few of the growers, they were usually applied only when the grower saw considerable evidence of insect injury. Arsenical and other inorganic insecticides were used during the preheading stage in all except one of the early autumn fields, but none of the winter-spring fields received such treatments. The average number of larvae maturing per 100 plants was 76 in the autumn crop and 272 in the winter-spring crop. Plantings close to fields with older infestations developed larger populations and showed a greater number of damaged plants than were to be found in others. From 2 to 63 per cent. of the plants were damaged by caterpillars in commercial fields, with an average of 19 per cent. for the autumn season and 23 per cent. for the winter-spring season. The study indicated that, as a whole, the damage was rather serious in spite of the growers' efforts, and that there was a need for more adequate control measures.

Glass (E. H.). **Host Plants of the Tobacco Flea Beetle.**—*J. econ. Ent.* **33** no. 3 pp. 467–470, 2 figs., 9 refs. Menasha, Wis., 1940.

Surveys and breeding experiments were carried out in Virginia in 1939 to determine the food-plants of the larvae and adults of the tobacco flea-beetle, *Epitrix parvula*, F., and their importance in maintaining or increasing populations. During April and May the adults were observed feeding on 13 plants ; they were most common on tobacco seedlings and young tomato plants and occurred on potato and on most solanaceous weeds when the plants first appeared in spring. They migrated to tobacco plants when these were set in the field, and the population increased from less than one to about 70 per plant during late spring and summer, but small numbers could be found throughout the summer in tobacco seed beds, on potato plants until these died and on jimson weed (*Datura stramonium*). Between the beginning of August and the middle of September, when the crop was being harvested, the beetles left the tobacco and attacked other solanaceous plants severely. Lists are given of these and of 40 other plants of various families on which they fed sparingly in late summer and early autumn.

To ascertain the food-plants of the larvae, beetles were caged for 4 days on plants on which they were known to feed and the cages were replaced to catch their offspring when they emerged as adults. Adults were obtained from all the 10 solanaceous plants tested, the largest numbers being from tobacco, *Datura stramonium* and potato, but not from any of the 16 non-solanaceous plants. Only three solanaceous weeds were found in or near tobacco fields, and there was no correlation between their presence and the abundance of *E. parvula* in the fields. Potato, on which the insect reproduced almost as readily as on tobacco, was the only cultivated solanaceous plant that occurred in the field early enough in spring to be an important food-plant before the tobacco was set and was often grown in the vicinity of tobacco fields. In fields near potato patches, the beetles appeared first on tobacco plants next to the potatoes, a generation having, in some cases, developed on the potato before the tobacco plants were set in the field.

Dominick (C. B.). **Migration of the Tobacco Flea Beetle.**—*J. econ. Ent.* **33** no. 3 pp. 470–472, 1 fig., 1 ref. Menasha, Wis., 1940.

In 1939, observations were made in Virginia by means of adhesive screens set up in and near tobacco fields on the migration of *Epitrix parvula*, F., from the time that the adults began to leave hibernation in spring until they entered hibernation in autumn. It was found that overwintered beetles were active from the end of March to the end of May. Many of them had evidently hibernated in débris at the edge of woodland, and on emergence they immediately migrated to the first available food-plants. Between the middle of May and early July there was definite migration from grassland and potatoes to newly set tobacco plants [*cf.* preceding abstract]. There was little movement in July and August, but the most extensive migration occurred in September, after the tobacco had been harvested. The largest numbers were caught at a height of 2–4 ft. from the ground, although some were caught as much as 22–24 ft. above the ground.

LEVIN (C.). **Breeding Hosts of the Tobacco Flea Beetle.**—*J. econ. Ent.* **33** no. 3 pp. 473–475, 2 refs. Menasha, Wis., 1940.

Investigations at Oxford, North Carolina, from 1935 onwards showed that adults of *Epitrix parvula*, F., invaded newly transplanted tobacco during two distinct periods, the first immediately after it was transplanted and the second about 2–3 weeks later, before a generation could have matured on the newly set tobacco. It was found in 1938 that the beetle did not breed freely on horse nettle (*Solanum carolinense*), the only wild food-plant that was abundant in or near the tobacco fields. The larvae developed on tobacco in seed beds, potato, tomato and nightshade (*S. nigrum*), and further studies were made in 1939 to determine the importance of the first two, since tomato is transplanted too late in the season to be important and *S. nigrum* has a limited distribution and occurs chiefly in the seed beds. Counts of adults emerging in cages over naturally and artificially infested plants showed that large populations were produced on both tobacco seedlings and potato, particularly during the early part of the season. The first-generation adults appeared soon after tobacco was transplanted, in late May and June, and adults continued to emerge from potatoes, apparently for as long as the roots were able to support the immature stages. Observations on tobacco seedlings indicated that the adults soon move from the seed beds, since they caused little injury, although the numbers emerging were large.

ISELY (D.). **Control of the Squash Bug by Calcium Cyanide.**—*J. econ. Ent.* **33** no. 3 pp. 475–477, 7 refs. Menasha, Wis., 1940.

In experiments in Arkansas in 1927–28, calcium cyanide dust, applied in the open, killed *Anasa tristis*, DeG., on squash when the bugs were actually hit, but usually injured the plants except in very dry weather [*cf. R.A.E.*, A **25** 246, etc.]. During dry weather in August 1938, calcium cyanide dust placed under the vines of small bush plants covered with canvas killed all the bugs during exposures of three minutes [*cf.* **23** 385] without injuring the plants. In 1939, flake calcium cyanide, which is cheaper, releases hydrocyanic acid gas more slowly and does not adhere to the foliage, was tested on large squash bushes between 27th June and 2nd August. A canvas trailer 9 ft. 6 ins. wide, which covered two rows at a time, was dragged over the plants as the insecticide was applied and left stationary for the various periods of exposure under trial. A dosage of 1 oz. per hill, applied on both sides of the plants, gave satisfactory control of *A. tristis* with an exposure of five minutes if about 8 fl. oz. water was poured on each dose of cyanide and with an exposure of ten minutes if water was not used. The average mortality of *A. tristis* was 98·3 per cent. in small plots and 91·1 per cent. on large sections. After exposures of 3–4 minutes, less than 80 per cent. of the bugs were killed or stupefied, and a dosage of ½ oz. cyanide killed only 56 per cent. with an exposure of 10 minutes.

The high cost of this treatment may prevent its use, but as it gives almost complete mortality of adults and nymphs of *A. tristis*, fewer applications are required than of a contact insecticide. It has no apparent effect on the eggs, however, so that a second application after they have hatched will be necessary in heavily infested fields. The dosage required will vary with the size of the plants and the

temperature and humidity at the time of application. Small plots were rapidly reinfested by migratory bugs, but there was no migration into a field the whole of which was fumigated with calcium cyanide in summer after the migration from hibernation had ceased.

DITMAN (L. P.), GRAHAM (C.) & CORY (E. N.). **Pea Aphid Control in Maryland during 1939.**—*J. econ. Ent.* **33** no. 3 pp. 477–481. Menasha, Wis., 1940.

An account is given of investigations in 1939, of which the main results have already been noticed [*R.A.E.*, A **28** 517–518], on the control of the pea Aphid [*Macrosiphum onobrychis*, Boy.] on peas in Maryland with sprays and dusts of derris and cubé, in the course of which two types of spray nozzle and two pressures were compared.

The following is based on the authors' summary ; From observations of the results of sweep records and from a statistical analysis of the results, derris appears to be more effective than ordinary cubé against *M. onobrychis* [*cf.* **28** 182, etc.]. Good kills obtained with micronised cubé indicate that fine grinding may increase the toxicity. Dusts appear to be slightly better than sprays under the conditions of application on these plots. Dusts applied at high humidity when dew was on the plants gave slightly better results than those applied later in the day when the temperature was higher, humidity lower and the plants dry.

DAHMS (R. G.) & PAINTER (R. H.). **Rate of Reproduction of the Pea Aphid on different Alfalfa Plants.**—*J. econ. Ent.* **33** no. 3 pp. 482–485, 1 fig., 8 refs. Menasha, Wis., 1940.

The results are given of laboratory experiments conducted between December 1934 and May 1935 to determine whether the susceptibility or resistance of varieties of lucerne to *Macrosiphum onobrychis*, Boy. (*Illinoia pisi*, Kalt.), as shown by the reaction of plants under heavy infestation in the field in Kansas in the spring of 1934 [*R.A.E.*, A **24** 461], was associated with the rate of reproduction of the Aphids on these plants. Aphids confined on resistant plants had a lower optimum temperature for life and reproduction than those on susceptible plants. On 16 resistant plants, the percentage of Aphids that were dead at the end of 10 days was 46·2 at 61°F. and 1·0 at 44°F., and the rates of reproduction were approximately equal ; on 10 susceptible plants, the percentage mortalities were 2·2 and 0·1, respectively, and the rate of reproduction was practically the same as that on resistant plants at 44°F. and about three times as high at 61°. The increase was less on the progeny of self-pollinated plants when these were 3 4 months old than on the parents in the case of both susceptible and resistant plants, but larger on the progeny of susceptible than of resistant plants, though there was great variation in this respect. Some plants that appeared to be resistant in the field furnished satisfactory food for Aphid reproduction ; such plants appear to be resistant because of their ability to withstand the feeding of the Aphid. The rate of reproduction was much greater on flowering branches than on vegetative branches of the same plant.

HAMILTON (C. C.). **Methyl Bromide Fumigation for Control of Asiatic Beetle Grubs attacking Azalea Plants.**—*J. econ. Ent.* **33** no. 3 pp. 486–490. Menasha, Wis., 1940.

The following is based on the author's summary of work on fumigation with methyl bromide against the larvae of *Anomala orientalis*, Waterh., which cause serious injury to azaleas in greenhouses and nurseries in northern New Jersey by destroying the roots and the bark of the stems up to soil level: Fumigation of the soil and azalea plants in raised benches and in floor benches by confining the methyl bromide under a fumigating box at the rate of 1 cc. per sq. ft. of area treated appeared to be safe and effective but the practical application of the method was rather difficult. It caused no injury to the plants in spring and only slight leaf burn to one variety in autumn. The soil temperatures varied from 54°F. in some spring tests to 81°F. in some of the autumn ones. Complete mortality was obtained in all tests except those made in spring when the soil temperature was 54°F. at a depth of 8 ins. and 58°F. at a depth of 4 ins. Injecting a solution of 1 part methyl bromide in 5 parts methyl or ethyl alcohol into the soil at the rate of 1 or 2 cc. methyl bromide per sq. ft. killed most of the larvae, but usually caused some injury to the plants, particularly at soil temperatures of about 80°F. The injured plants were usually those nearest the points of injection, and when the injections were made at intervals of 6 ins. instead of 10–12 ins., with a dosage of 0·5 cc. methyl bromide per injection, injury, if it occurred, was slight. It is considered that this method of application to soil containing growing plants will always be accompanied by some plant damage because of the initial heavy concentration of the gas at the point of injection.

Diluting the solution in water (200 cc. in 3 U.S. gals.) and sprinkling it over the area to be treated at the rate of 1 cc. methyl bromide per sq. ft. gave satisfactory mortality without injuring the plants under most conditions, but applications at lower rates were ineffective. There appeared to be some danger of injuring the roots and stems of the plants where the soil was rich in humus and was wet at the time of application, but it is considered that with proper attention to the physical condition and temperature of the soil, this treatment would give effective control of *A. orientalis* without injury to the plants.

Most of the injury was caused to plants in raised benches made from cement slabs, which did not permit the vapour to escape downwards very readily. Where the soil was 10–12 ins. deep, the vapour was not retained in concentrated amounts round the roots and stems, the plants were not injured and larvae at depths of 10–11 ins. were killed.

Tests in fallow soil in the greenhouse showed that a satisfactory kill of the larvae could be obtained with chloropicrin injected at the rate of 2 cc. per sq. ft. 3–4 ins. below the surface; with carbon bisulphide applied in shallow furrows about 10 ins. apart at the rate of $\frac{3}{4}$ oz. per sq. ft.; and with a mixture of methyl bromide and methyl alcohol injected into the soil at the rate of 1 cc. methyl bromide per sq. ft. These materials are probably equally effective against *A. orientalis*, but plants cannot be set until all the carbon bisulphide or chloropicrin has escaped from the soil, which may take up to 2 and 3 weeks, respectively, whereas they may be set in soil treated with methyl bromide within 2–3 days.

JOHNSON (G. V.) & SMITH (F. F.). **Field Control of the Gladiolus Thrips.**—*J. econ. Ent.* **33** no. 3 pp. 490–493, 5 refs. Menasha, Wis., 1940.

Tests of sprays containing various quantities of tartar emetic (potassium antimony tartrate) and brown sugar against the gladiolus thrips [*Taeniothrips simplex*, Morison] in 1938 [*R.A.E.*, A **28** 576] showed that the quantities previously recommended could be reduced considerably. During 1939, there was no significant difference in the control (about 90 per cent. with greatly increased production of first grade flowers) given by sprays containing 2 lb. tartar emetic with 2 or 4 lb. brown sugar, 4 lb. tartar emetic with 8 or 16 lb. brown sugar, or 4·4 lb. calcium antimony tartrate with 16 lb. brown sugar, per 100 U.S. gals. water, and technical tartar emetic was as effective as tartar emetic U.S.P. The calcium antimony tartrate, which costs 20 per cent. less than the cheaper grade of tartar emetic, was tested at a higher concentration because it contains 10 per cent. less antimony. No damage was caused to the plants by any of the sprays. Other sprays tested in 1938 [*cf. loc. cit.*] included derris, nicotine sulphate and tartar emetic in combination with various adhesives and spreaders. All proved greatly inferior to the sprays of tartar emetic and brown sugar, which are applied in droplets, though in some cases a heavier deposit in droplets and in others a uniform film of insecticide was obtained.

ANNAND (P. N.). **Recent Changes in Agriculture and their Effect on Insect Problems.**—*J. econ. Ent.* **33** no. 3 pp. 493–498. Menasha, Wis., 1940.

The main part of this paper comprises a review of the effect on the problems of insect control of the changes in agricultural practice that have recently taken place in the United States as a result of the national agricultural programme, including soil conservation by such methods as the planting of trees and shrubs to control erosion, strip farming and the maintenance of soil cover, proper land use and the retirement of unproductive lands, and the conservation of wild life. The importance of establishing adequate insect control practices as a concomitant to the development of crop insurance, the storage of large quantities of grain on farms and the adjustment of supply to demand is discussed.

DIBBLE (C. B.). **Grasshoppers, a Factor in Soil Erosion in Michigan.**—*J. econ. Ent.* **33** no. 3 pp. 498–499. Menasha, Wis., 1940.

The most severe grasshopper infestations in Michigan have occurred in areas where the lighter soils predominate, chiefly in abandoned cleared farm lands and cleared areas that had been burned over by forest fires and were being widely used as pasture for cattle. Serious and widespread infestations occurred in 1917–19 and 1933–35, after which large areas of land went out of agricultural use. Severe wind erosion, and in some cases water erosion, occurred in these areas in the west of the State and in other places with sandy soils. In some instances, several acres were denuded of soil in two years in old fields where there had been a good stand of grass and where a fair stand remained beneath and on the north side of thick trees or tall hedges.

Grass growing in the shade was as heavily grazed as that in the open when the infestation began and more heavily later, but persisted in spite of competition with the trees for moisture, whereas the grass disappeared in the open, where the sunlight permitted the hoppers to feed more heavily and probably later in the season. Natural seeding could not take place on these sites while the grasshoppers were present in large numbers, but large areas in which poison bait was used in 1935–36 showed a definite increase in ground cover, the rapid development of which was assisted by unusually heavy rainfall. Severe grasshopper infestations with populations of 15–40 per sq. yard thus aggravate the soil erosion caused by overgrazing.

The relative abundance of the various species of grasshoppers in Michigan changes with the ground cover. *Camnula pellucida*, Scudd., predominated on many sites in 1934, but *Melanoplus mexicanus*, Sauss., was more important on many sites where grass was scarce in 1935. *M. mexicanus* persisted where there was no grass after mid-summer, feeding on weeds and moss, and deposited sufficient eggs to maintain a relatively large population. *Ageneotettix deorum*, Scudd., became the most important species in many areas as erosion increased. Its eggs are most often found at the northern edges of sandy ground where the exposure to the sun is greatest. *C. pellucida* tended to be the most numerous where the grass was not completely killed and when a season of favourable weather occurred. The weather is the greatest factor influencing population and the relative abundance of the species, particularly at the hatching period, since hoppers may hatch on warm days and die if cool weather follows.

FLINT (W. P.). **Evaluation of Insect Damage under the Crop Insurance Plan.**—*J. econ. Ent.* **33** no. 3 pp. 499–501. Menasha, Wis., 1940.

The only Federal crop insurance in operation in the United States at the present time is that for wheat, under which the crop may be insured for a loss of either 50 or 70 per cent. of its value, determined from the average yield of wheat over a period of years on the farm and on all farms in the county in which the insured field is located. Negligence of any essential part of the wheat-growing operation, including planting before the recommended safe date for Hessian fly [*Mayetiola destructor*, Say], cancels the insurance. In connection with the possibility of extending Federal insurance to other crops, it is pointed out that the plan adopted avoids the difficulty of evaluating the damage caused by insects as such, makes it possible to require proper measures to be taken against pests that can reasonably be expected to occur, and affords adequate cover for insect outbreaks that cannot be foreseen.

LILLY (J. H.). **The Effect of arsenical Grasshopper Poisons upon Pheasants.**—*J. econ. Ent.* **33** no. 3 pp. 501–505, 1 fig., 4 refs. Menasha, Wis., 1940.

The following is based on the author's summary: Young pheasants are unlikely to be poisoned by eating arsenical baits, as the baits are usually spread too thinly to make them readily available and are decidedly unpalatable to the birds. Caged pheasants consumed grasshoppers dead and dying as a result of eating arsenical baits almost as readily as they did unpoisoned grasshoppers, but a young pheasant

that had eaten comparatively large quantities of bait containing sodium arsenite and another one fed exclusively on poisoned grasshoppers for 12 days showed no gross pathological symptoms when autopsied, and neither of them retained significant quantities of arsenic in the body tissues subsequently analysed. The experiments described indicate that grasshopper poisoning campaigns are not an important menace to young pheasants or to individuals who may eventually consume birds so exposed.

FAHEY (J. E.) & RUSK (H. W.). **Effect of Fruit Growth and Weather on Deposits of Insecticides on Apples in Southern Indiana.**—*J. econ. Ent.* **33** no. 3 pp. 505–511, 4 figs., 14 refs. Menasha, Wis., 1940.

The following is based on the authors' summary: Investigations were carried out in southern Indiana during 1935–38 to determine the effect of fruit growth and weathering on the deposits resulting from the application of various sprays of lead arsenate, fixed nicotine and phenothiazine [thiodiphenylamine] against the codling moth [*Cydia pomonella*, L.] on apple. Fruit samples for chemical analysis were taken before and after each spray application and at harvest from three horizontal sections of the trees according to the normal crop distribution on them. Similar samples for fruit-growth studies were taken from the same trees and from others in the vicinity at the time of each spray application.

Growth records of Grimes Golden apples for four consecutive years and of several varieties for one year showed that the rate of growth differed according to the variety of fruit, but only to a slight extent according to seasonal conditions. Fixed nicotine was found to be less susceptible to weathering than thiodiphenylamine, and more susceptible than lead arsenate. Fruit sprayed with lead arsenate retained at harvest from 51·5 to 76·1 per cent. of the total residue deposited during the season [*cf. R.A.E.*, A **26** 320]. Fruit sprayed with fixed nicotine retained from 8·4 to 32·6 per cent. of the total residue, depending on the interval between the final cover spray and harvest and on the rainfall.

HANSBERRY (R.), MIDDLEKAUFF (W. W.) & NORTON (L. B.). **Toxicity of Nicotine administered internally to several Species of Insects.**—*J. econ. Ent.* **33** no. 3 pp. 511–517, 21 refs. Menasha, Wis., 1940.

The manner in which fixed nicotines act against newly hatched larvae of *Cydia* (*Carpocapsa*) *pomonella*, L., is not precisely known. They are believed to act primarily through the digestive system, but there is little experimental evidence as to this. The action of nicotine in various forms, administered by feeding in leaf sandwiches, was therefore tested on leaf-eating Lepidopterous larvae of several families and on larvae and adults of *Leptinotarsa decemlineata*, Say. Susceptibility or resistance appeared to be more closely related to the species of insect than to the chemical or physical properties of the nicotine compound. The mortality of most of the larvae was low, and many ate large quantities without being affected, but larvae of *Bombyx mori*, L., survived no doses of nicotine above 0·017 mg. per gm. body weight. Nicotine was definitely repellent to several species, and in some cases it was impossible to administer measurable doses. It was also highly repellent to adults of *Rhagoletis* spp. when given in honey solution.

The mortality of larvae and adults of *L. decemlineata* was low except in the case of adults fed with nicotine reineckate (the insoluble compound of nicotine and Reinecke's salt) ; the median lethal dose of this compound was estimated as only 0·004 mg. nicotine alkaloid per gm. body weight, its effect was apparent within 15 minutes of feeding and death generally occurred in 2–6 hours. It was also much more toxic than uncombined nicotine to one of the six species of Lepidoptera on which it was tested. When nicotine alkaloid was injected into the blood or gut, mortality was higher in some cases than when it was given in sandwiches, but it was still low except in the case of *B. mori*, and there was no significant difference between the two methods of injection. It was tested by injection on larvae of *C. pomonella* that had developed almost to maturity in apples, and they were more resistant than would have been expected, since newly hatched larvae are generally considered to be highly susceptible to nicotine.

Neiswander (C. R.) & Morris (V. H.). **Introduction of Selenium into Plant Tissues as a Toxicant for Insects and Mites.**—*J. econ. Ent.* **33** no. 3 pp. 517–525, 7 figs., 5 refs. Menasha, Wis., 1940.

An account is given of experiments carried out in Ohio in 1937–39 to determine the effect of accumulations of selenium in plant tissues on infestation by *Tetranychus telarius*, L., the relative accumulations of selenium in the tissues of plants supplied with different quantities of the material in the form of sodium selenate in nutrient solutions and in soils and the effect of such accumulations on the plants. A single experiment was also carried out with *Macrosiphum* (*Macrosiphoniella*) *sanborni*, Gill., on chrysanthemums grown in a nutrient solution. Populations of the mite were practically eliminated on foliage containing about 90–100 parts per million selenium, and those of the Aphid on leaves containing 45 p.p.m., which the chrysanthemums obtained from a nutrient solution containing 2 p.p.m. Significant reductions of both mites and Aphids occurred when only half these quantities were present. Concentrations of selenium in the tissues adequate for practically complete control of *T. telarius* were obtained on tomato plants by the addition of 1½ p.p.m. selenium to the nutrient solution and in carnations by the addition of 6 p.p.m. to the soil in which they were grown. Carnations grown in a nutrient solution did not appear to absorb sufficient selenium to affect the mites, and both stocks [*Matthiola*] and roses absorbed less from nutrient solutions than tomato plants receiving equal dosages, but showed a definite decrease in infestation. Tomato plants receiving 2 p.p.m. selenium and the control plants were retarded in growth by selenium toxicity and mite injury, respectively, but roses grown in nutrient solutions containing 2½ p.p.m. selenium grew well, and those receiving only ½ p.p.m. lost most of their leaves, the remainder being grey with mite injury.

It is probable the under natural conditions smaller amounts of selenium might prevent the development of destructive populations of mites and Aphids. The concentration in the tissues of those plants that absorbed only small quantities could probably be increased by reducing the proportion of sulphate or increasing that of selenium in the growth medium.

McGovran (E. R.), Cassil (C. C.) & Mayer (E. L.). **Particle Size of Paris Green as related to Toxicity and Repellency to the Mexican Bean Beetle.**—*J. econ. Ent.* **33** no. 3 pp. 525–531, 2 figs., 8 refs. Menasha, Wis., 1940.

An account is given of laboratory experiments in which three well defined fractions of Paris green of which the diameters of the particles averaged 22, 12 and 1·1 microns, respectively, were tested on bean leaves as stomach insecticides against adults and larvae of *Epilachna varivestis*, Muls., collected from bean fields in Maryland. The methods used in preparing the fractions and testing are described. The percentage mortalities in 48 hours of old adults of the second generation and (in brackets) the areas of leaf consumed in sq. cm. averaged 29 (6·5), 40 (3·9), 53 (1·1) and 13 (34·6) for the three fractions applied as aqueous suspensions and untreated leaves, respectively, while the corresponding averages when the materials were applied as dusts against third-generation adults were 43 (4·5), 61 (2·3), 88 (0·3) and 15 (82·4), respectively, and 19 (44·8) for leaves dusted with talc. The average deposits on the leaves were 31–32 and 105–110 micrograms per sq. cm. for the sprays and dusts, respectively. The largest surface area of insecticide was ingested in the case of the smallest fraction, though the smallest leaf area and weight of insecticide were ingested. There was little difference between the other fractions. In preliminary spray tests with larvae in the second instar, deposits of 14–16 micrograms per sq. cm. of the three fractions gave 35, 46 and 85 per cent. mortality, respectively, while that on untreated leaves was 14 per cent.

It is considered that the larger surface area of the smallest fraction and the greater amount of water-soluble arsenic in it allowed rapid absorption of the insecticide and caused the insects to stop feeding in a short time, whereas the other fractions, with relatively small surface areas and less water-soluble arsenic, did not affect the insects so rapidly, so that larger amounts were ingested. Visible quantities of Paris green adhered to the beetles fed on foliage dusted with the finest material, and part of this material may have entered the insects, causing a toxic action. Under field conditions, Paris green is very toxic to bean foliage, but in the laboratory, where only the upper surfaces of the leaves were sprayed, practically all the toxic effect was eliminated.

Livingstone (E. M.), Easter (S. S.) & Swank (G. R.). **Methyl Bromide in aqueous Solution to control** *Pantomorus leucoloma* **and** *P. peregrinus*.—*J. econ. Ent.* **33** no. 3 pp. 531–533. Menasha, Wis., 1940.

The results are given of investigations on the control of larvae of *Pantomorus leucoloma*, Boh., and *P. peregrinus*, Buchanan, in burlapped balls of earth such as would occur on the roots of nursery stock by treatment with an aqueous solution containing 0·3 per cent. methyl bromide and 0·6 per cent. denatured ethyl alcohol [*cf. R.A.E.*, A **28** 490]. Burlapped balls of earth infested with the larvae were plunged in water-tight sand boxes at least two inches from each other and the top and bottom of the sand, and the insecticide was sprinkled on the sand at the rate of 40 U.S. gals. per 100 sq. ft. surface. The temperatures at which the tests were carried out usually averaged between 70 and 80°F. The balls of earth were left in the sand for

various periods, and the insect material was removed 24 hours after the expiration of the period of treatment and kept for observations on mortality. The mortality of larvae of *P. leucoloma* was incomplete in balls of 5 ins. minimum diameter after 8 hours' exposure and in those of 7 ins. after 24, but was complete in those of 5 and 6 ins. after exposures of 12 and 18 hours, respectively. Complete kills were obtained of larvae of *P. peregrinus* in balls 3–7 ins. in diameter with exposures of 4 hours. The apparent difference in susceptibility of the two species is attributed to the difference in soil types, since near New Orleans, where the experiments with *P. leucoloma* were carried out, the soil is a dense, compact sandy clay of alluvial origin, whereas near Gulfport, where *P. peregrinus* is found, the soil is a loose and porous sandy loam. In preliminary experiments to determine the effect of the fumigant on plants, various ornamentals showed little or no retardation in growth after treatment.

Smith (R. H.). **Winter Mortality of the Black Scale (*Saissetia oleae* Bern.) on Oranges in California.**—*J. econ. Ent.* **33** no. 3 pp. 534–535. Menasha, Wis., 1940.

Treatments applied in August–October for the control of *Saissetia oleae*, Bern., on orange in California are usually considered satisfactory if infestation is lower in the early summer of the following year. The author, however, records observations that show that the reduction in infestation at this period depends largely on the rate of natural mortality of the Coccid during the winter and spring. In a grove sprayed in September 1931, natural mortality between October 1931 and June 1932 reduced the population by 56·58 per cent. on sprayed trees and by 69·21 per cent. on unsprayed trees. The higher mortality on the untreated trees may have been the result of the very dense insect population. In another grove treated in September 1932, the percentage of natural mortality between October 1932 and June 1933 was 89·11 on sprayed trees and 84·11 on unsprayed ones. Though the second grove had more than twice as many insects as the first in September, it had only about half as many in the following June, the percentage dying from natural causes being almost as large as the percentage killed by the spray in certain tests. Observations made on two orange trees in 1935–36 are given in more detail. The natural mortality of *S. oleae* on these trees amounted to 93·32 per cent. in the autumn, winter and spring, as a result of which the infestation was lighter a year after spraying than before and it was considered that the treatment had given adequate control. If the natural mortality had been as low as in the other two instances cited, the infestation a year after spraying would have been so heavy that the treatment would have been considered unsatisfactory.

Knight (K. L.). **Fumigation of sacked Grain with Chloropicrin.**—*J. econ. Ent.* **33** no. 3 pp. 536–539. Menasha, Wis., 1940.

The investigations described were carried out to determine the dosages of chloropicrin required for the control of insects infesting seeds stored in various types of bags. Wheat infested with mixed cultures of *Tribolium castaneum*, Hbst., *Rhizopertha dominica*, F., *Calandra* (*Sitophilus*) *granaria*, L., *C.* (*S.*) *oryzae*, L., and *Laemophloeus minutus*, Ol., was treated by injecting the chloropicrin into the sack in

quantities proportional to its volume (calculated from the weight of grain in it) or by releasing the fumigant into a vault holding the sacks. The temperature ranged from 68 to 84°F. and the relative humidity averaged 45 per cent. *T. castaneum* was found to be the most resistant of the insects used and is the only one for which results are recorded. The results were checked by placing infested wheat in permeable containers in various situations in the filled bags, and samples were taken 4 and 7 days after fumigation by injection and immediately after fumigation for 24 hours in the vault and again 7 days later. The results showed that a dosage of 1 lb. per 1,000 cu. ft. gave complete control in 7 days when injected into gas-tight bags, whereas one of 14 lb. gave very erratic results in porous bags. In vault fumigation, 12 oz. per 1,000 cu. ft. gave complete control in porous bags, and 3 lb. per 1,000 cu. ft. gave 90·5 per cent. mortality in moderately gas-tight bags. With either method of application, considerable post-fumigation mortality resulted when the grain was left undisturbed in the sack for a week.

The advantages of fumigation by injection are the cheapness of the equipment and the fact that the gas-tight sacks necessary for this method reduce reinfestation of the fumigated grain. Those of vault fumigation are that it is not necessary to perforate the sack, the porous bags used are cheaper than the gas-tight bags and the method is more economical for large quantities of grain.

The viability of maize, oats, wheat and soy beans with a moisture content low enough for safe storage (below 14 per cent.) was not significantly decreased by fumigation with chloropicrin at rates requisite for complete insect control in sacked grain.

BAILEY (S. F.). **The Black Hunter,** *Leptothrips mali* (**Fitch**).—*J. econ. Ent.* **33** no. 3 pp. 539–544, 1 fig., 34 refs. Menasha, Wis., 1940.

Leptothrips mali, Fitch, is one of the most common and widely distributed of the predacious thrips in North America, but is usually of minor importance in the control of injurious insects as it occurs in small numbers and has a very low reproductive capacity. Fertilised females have never been observed to give rise to more than a single larva, though females containing two eggs have been collected, and more than two larvae are rarely found on apple leaves heavily infested with Eriophyid mites. All stages of the thrips are briefly described, its distribution and taxonomic position are discussed and lists are given of the plants on which it was found and of insects and mites on which it feeds in California. It attacks eggs and crawlers of *Lecanium corni*, Bch., on apricot, and mites, red-spider eggs and thrips larvae on peach. It has also been stated [*cf. R.A.E.*, A **24** 173] to destroy eggs of the peach twig borer [*Anarsia lineatella*, Zell.]. It is less common than *Scolothrips sexmaculatus*, Perg. [*cf.* **27** 410] where infestations of red spiders, particularly web-spinning species, are well established, but preys on Eriophyids to a much greater extent, sometimes almost completely controlling *Calepitrimerus baileyi*, Keifer, on apple leaves in late summer, and probably attacking *Eriophyes vitis*, Land., on grape vine and *E. ryderi*, Banks, on maple. It destroyed entire colonies of *Frankliniella moultoni*, Hood, and *Drepanothrips reuteri*, Uzel, in cages, but is less effective against these species on vines and fruit trees as it attacks mites and young Aphids as well. It does not attack thrips that infest annual crops growing in ploughed fields, on

account of the lack of suitable hibernation sites, or the pear thrips [*Taeniothrips inconsequens*, Uzel], because the latter occurs too early in the year. It has been observed preying on the eggs of the black scale [*Saissetia oleae*, Bern.] and on nymphs of the walnut aphis [*Chromaphis juglandicola*, Kalt.] and is known to attack the pecan nut casebearer [*Acrobasis caryae*, Grote] and *Bryobia praetiosa*, Koch, on almond.

Investigations on *L. mali* on apple, carried out in California during 1936–39, showed that the adults of both sexes normally hibernate in sheltered places on the tree between October and March. Larvae of the first generation were first observed in the last week in April, and those of the second appear during late June and early July. The third generation, which occurs during August and early September, is small and scattered, apparently as a result of the decrease in the food supply or the greater dispersion of the thrips. The eggs are laid chiefly on the lower leaf surface, and the larvae pupate in protected places on the tree.

Hetrick (L. A.). **Some Factors in natural Control of the Southern Pine Beetle, *Dendroctonus frontalis* Zimm.**—*J. econ. Ent.* **33** no. 3 pp. 554–556, 3 refs. Menasha, Wis., 1940.

Examinations of pine bark infested by *Dendroctonus frontalis*, Zimm., in Virginia in 1938–39 showed that many of the larvae were dead and infested with Nematodes and some were apparently infected with a pathogenic fungus. It was found in 1939 that 51·3, 2·6 and 8·3 per cent. of the larvae, pupae and adults of the overwintering generation and 35·1, 5·7 and 0 per cent. of those of the first generation had died in the bark from natural causes other than parasitism by insects. Nematodes were obtained from 79 and 37 per cent., respectively, of dead and living individuals of the overwintering generation in the field, from 60 per cent. of adults of this generation that emerged from bark placed in the insectary, and from 68, 27 and 49 per cent., respectively, of corresponding insects of the first generation. The succeeding generation was too small for investigation. The Nematodes belonged to two undescribed species ; one was an endoparasite of the genus *Anguillonema* and the other an associate of *D. frontalis* of the genus *Aphelenchoides*, the larvae of which attach themselves beneath the elytra of the adults for transport. It is considered likely that the parasitic Nematode passes through a free-living stage in the course of its development and must have moisture in the cambium tissues of the dying trees in order to make its way to the developing brood ; this is dependent on sufficient rainfall to soak the loosening bark. The rainfall was adequate in the infested area during the winter of 1938–39, and this may account for the high rate of parasitism by the Nematode.

Mites were found on the bodies of 17 and 62 per cent. of the adults of the overwintering and first generations that emerged in the insectary. They belonged to five species in four families. The percentage of parasitism of all stages of *D. frontalis* by insects was 0·39 for the overwintering generation and 10 for the first generation. The parasites bred, in order of importance, were *Coeloides pissodis*, Ashm., *Cecidostiba dendroctoni*, Ashm., *Spathius canadensis*, Ashm., *Heydenia unica*, Cook & Davis, *Rhoptrocerus* (*Pachyceras*) *eccoptogastri*, Ratz., and *Dendrosoter sulcatus*, Mues.

Nematodes may have been one of the factors responsible for the decline in infestation by *D. frontalis* that occurred in Virginia in 1939 ;

others included the nearly normal rainfall, which improved the vitality of the trees, the abundance of bird and insect predators, and periods of mild weather in winter, which caused the emergence of many adults that were apparently unable to attack the trees at that season.

FELT (E. P.). **European Elm Bark Beetle and Dutch Elm Disease Control.**—*J. econ. Ent.* **33** no. 3 pp. 556–558. Menasha, Wis., 1940.

The author discusses the spread of the Dutch elm disease, caused by *Ophiostoma* (*Ceratostomella*) *ulmi*, in New Jersey, since it was first observed there in 1933. *Scolytus multistriatus*, Marsh., the principal vector of the fungus, normally breeds in dying or diseased elm wood, and attempts made in New Jersey in the autumn of 1936 and the spring of 1937 to prevent its breeding by killing 600,000 trees with chemicals proved unsuccessful, as a survey in the following year showed considerable numbers of infected elms in a band a mile wide round the treated trees. The fact that 75 per cent. of the infected trees were in the inner half mile of the band indicates a normal relatively short beetle flight and consequently a usually limited spread of the disease. It is probable, however, that some of the beetles are carried relatively long distances by wind [*cf. R.A.E.*, A **25** 374, etc.], and this is confirmed by the finding of diseased trees at long distances from areas previously known to be infected.

Recently published figures indicate an inevitable spread of the disease, and it is probable that many infected trees have not been located and will not be found in the near future; furthermore, the present policy of attempting to eradicate *S. multistriatus* is likely to prove too expensive. In view of the fact that the beetle is chiefly a local insect and is rarely found except in diseased or dying wood and that an extensive or overwhelming invasion from neighbouring territory is unlikely, owing to the normal limit of flight, the author suggests that local control in cities and villages might be effected at a low cost by two or three summer prunings and the immediate burning of weak wood. He points out that the prompt removal of breeding material in most of the infected area is more important for local protection of trees than a knowledge of the exact cause of the sickly or dying condition, and that there seems to be little advantage in the costly procedure of searching out and destroying occasional diseased trees in remote woodland, since these are of little danger to valuable elms in towns.

BURGESS (A. F.). **The Value to uninfested States of Gypsy Moth Control and Extermination.**—*J. econ. Ent.* **33** no. 3 pp. 558–561. Menasha, Wis., 1940.

A brief account is given of the campaign against the gipsy moth [*Lymantria dispar*, L.] carried out since 1906 in the United States by the Federal Government, the New England States, New York and New Jersey, including the establishment of the barrier zone in 1922. For 16 years the maintenance of this zone and the extermination of outlying infestations have prevented the general westward spread of the moth [*cf. R.A.E.*, A **28** 340] and protected unaffected States from loss of trees due to it and from the expense of its control. The present position, however, is serious. Before the discovery of a heavy infestation in Pennsylvania in 1932 [**21** 258], the funds supplied for this work were reduced by 37 per cent., and they have not since been

increased. The number of men employed, which reached more than 5,000 in 1936, has decreased progressively to the present total of less than 800, and, particularly in the large forested areas where most of the work is done, there are insufficient men available to cover all the territory that should be examined. During the last few years infestation has increased and large areas near the barrier zone have been defoliated ; for two or three years there has been a spread of small larvae carried by the wind, and the hurricane that swept New England in September 1938 undoubtedly carried many egg clusters into the zone on leaves, bark or other material, so that unusually large numbers of infestations from single egg clusters have been found in the barrier zone since July 1939. It is clear that unless thorough control measures are carried out on the small infestations in there and in other localities where they are urgently needed, the barrier zone and the work of extermination that is being carried out in north-eastern Pennsylvania on the most westerly infestation known in the United States will fail to protect the rest of the country. It is suggested that the States that have been protected for many years should give some help in the campaign for their further protection.

LINSLEY (E. G.). **Notes on** *Oncideres* **Twig Girdlers.**—*J. econ. Ent.* **33** no. 3 pp. 561–563, 13 refs. Menasha, Wis., 1940.

The Lamiid twig girdlers of the genus *Oncideres* have long attracted attention owing to the injury they cause to broad-leaved trees, including those grown for fruit, nuts, shade and ornamental purposes. The species have, however, been commonly misidentified. In view of this, the author gives a brief review of the principal species in the United States, including references to the more important papers on them, showing their synonyms and the names under which they have been recorded, notes on their distribution and the trees they attack, and records of other insects that breed in the twigs and branches girdled by them.

REINHARD (H. J.). **The Life History of** *Phyllophaga lanceolata* **(Say) and** *Phyllophaga crinita* **Burmeister.**—*J. econ. Ent.* **33** no. 3 pp. 572–578, 8 refs. Menasha, Wis., 1940.

Various species of *Lachnosterna* (*Phyllophaga*) are becoming increasingly important as pests of agricultural crops in Texas, and laboratory studies on their life-histories were therefore begun in 1937. The investigations in 1937–39 were on *L.* (*P.*) *lanceolata*, Say, and *L.* (*P.*) *crinita*, Burm., both of which have a one-year life-cycle ; the larvae were fed on grapenuts, which proved to be a more adequate diet than the sprouted grain kernels commonly used.

L. lanceolata is one of the best known species of the genus in the south-western United States. The males have normally developed wings, but those of the females are not functional. The adults have caused extensive local damage to vegetable crops and cotton in Texas during recent years, but the larvae almost certainly cause greater losses by attacking young wheat in the north-west of the State ; they have recently been recorded as causing severe damage to wheat in Oklahoma. Both larvae and adults occur in native grassland, but their importance as pests of pasture grasses in the State is not known. The adults are diurnal in habit and feed most commonly on cotton ; they have also

been observed feeding on beans, cowpeas and potatoes, but feed more frequently on certain species of weeds. A list is given of plants on which they fed in cages.

The following is based on the author's summary of the life-cycle under Texas conditions: The adults emerge in maximum numbers in May, and oviposition begins during the same month. Larvae with access to an abundance of food develop rapidly and attain full growth within a period of 3–4 months; pupation begins by mid-April of the following spring, and pupae are generally present early in May. The durations of the egg, larval and pupal stages average about 19, 327 and 19 days, respectively.

L. crinita, which is associated with other species injuring vegetable crops and lawns in various parts of Texas, is particularly abundant in the lower Rio Grande Valley, where the larvae have damaged maize. The adults, both sexes of which can fly, are nocturnal in habit and have been observed feeding on pecan and *Citrus*. The larva is an important pest of cabbage and is probably one of the most important of the white grubs attacking parsley; heavy populations were observed in one district in lawns of Buffalo grass [*Stenotaphrum*], to which they did considerable damage over limited areas during 1938.

The following is based on the author's summary of the complete life-cycle: The beetles begin to emerge in May and are commonly active throughout June. The earliest oviposition in the laboratory was observed on 25th May and the last on 13th July. The larvae feed for two or three months and attain full growth during September or October, after which they remain quiescent throughout the winter. Pupation begins about mid-April, and pupae occur commonly in May. The egg, larval and pupal stages last about 13, 281 and 20 days, respectively.

Weigel (C. A.) & Johnson (G. V.). **Tartar Emetic Sprays against Red Spider.**—*J. econ. Ent.* **33** no. 3 pp. 579–580, 1 ref. Menasha, Wis., 1940.

In a preliminary test made on greenhouse cucumbers, three applications of a spray containing 4 lb. tartar emetic and 16 lb. brown sugar per 100 U.S. gals. water gave 100 per cent. mortality of *Tetranychus telarius*, L., but caused rather serious scorching of the foliage and reduction in yield. On an autumn crop of greenhouse cucumbers, sprays containing 2 or 4 lb. tartar emetic with either 8 or 16 lb. brown sugar per 100 U.S. gals. gave percentage mortalities of 98·3–99·3 and caused only slight injury to the foliage, this being more pronounced with the higher concentration of tartar emetic. It has been observed by F. F. Smith that gladiolus plants in greenhouses treated with such sprays for the control of *Taeniothrips simplex*, Morison, were practically free from *Tetranychus telarius* for six weeks after the last spray had been applied, whereas untreated plants were infested.

Further tests were carried out with infested carnation cuttings to find an effective spray containing tartar emetic that would not leave the objectionable sticky residue caused by the sugar. All quantities of materials given are per 100 U.S. gals. water. Sprays of 2 lb. tartar emetic with 4 lb. sugar and with 3 U.S. gals. of a molasses-like by-product of the maize-syrup industry killed 95·7 and 89·9 per cent. of the mites, respectively, but the sticky residue was not avoided by the reduction in quantity of sugar and was rendered more objectionable

by the by-product. When used with 2 and 3 U.S. gals. glycerine, 2 lb. tartar emetic gave percentage mortalities of 90·3 and 93·4, respectively, and the sprays did not leave a sticky residue or one that would be washed off by the normal watering of the plants, but smaller quantities of glycerine did not give consistently good control, even when the proportion of tartar emetic was increased. Very low rates of mortality were obtained with the other sprays tested, which comprised 2 lb. tartar emetic with 4 lb. dextrin, 2 lb. of a proprietary skim-milk product or 1 U.S. gal. white-oil emulsion, 1–8 lb. tartar emetic with $4\frac{1}{4}$ oz. sodium lauryl sulphate or $1\frac{1}{4}$ U.S. pints sodium oleyl sulphate with or without a synthetic resinous sticker, tartar emetic alone and brown sugar alone.

Noble (W. B.), Cartwright (W. B.) & Suneson (C. A.). **Inheritance of Resistance to Hessian Fly.**—*J. econ. Ent.* **33** no. 3 pp. 580–581, 1 ref. Menasha, Wis., 1940.

Further work in California on the inheritance of resistance of wheat to *Mayetiola* (*Phytophaga*) *destructor*, Say [*cf. R.A.E.*, A **24** 615] indicated that a resistance less pronounced than that of the Dawson variety occurred in some wheat strains and varieties of the Java type. Two of these strains were crossed with Dawson, and the resultant hybrids were tested during 1938 and 1939. The infestations of *M. destructor* during this period were insufficient for an exact factorial analysis of the data in the F_2 or F_3 generation, but the segregations observed were inducive to further studies; comparative infestations of parents, hybrids and susceptible checks are shown in tables.

Bushnell (R. J.). **Destruction of an experimental Population of Bean Weevil by** *Pediculoides ventricosus* **Newport.**—*J. econ. Ent.* **33** no. 3 pp. 581–582, 3 refs. Menasha, Wis., 1940.

During breeding experiments with *Bruchus* (*Acanthoscelides*) *obtectus*, Say, an infestation of the mite, *Pediculoides ventricosus*, Newp., spread to the cultures, which were in two-ounce salve tins in an incubator, from a stock of *B. quadrimaculatus*, F., that was collected in Georgia in the autumn of 1937. The young mites appeared to prefer the eggs of *B. obtectus* as food and removed the entire contents, leaving only the flattened chorion. Occasionally two or three fed on the same egg. When several mites invaded a single culture, all the host eggs were soon destroyed, but one or two mites did not destroy more than five or six eggs. The mites matured after feeding on the eggs for 2–3 days, and gravid females produced offspring after about a week at 27°C. [80·6°F.], some of them producing as many as 40 progeny a day 3–4 days after they began to reproduce. The large numbers of young mites thus produced destroyed the eggs of the Bruchid, killed newly hatched larvae before they entered the beans or entered the burrows of the larvae and killed them before they had developed to any great extent, thus destroying the entire culture. If most of the eggs had hatched before the mites entered the culture some of the larvae escaped attack by the first generation, but young mites of the second or third generation usually attacked the older larvae and pupae. Some individuals that were attacked during the late pupal stage were able to emerge as adults, but many of these had abnormal elytra with thirty or

more mites beneath them and died in about a day. Adult Bruchids carrying only a few gravid mites were able to fly and oviposit, and would probably be effective in distributing the mites in nature. Attempts to obtain uninfested cultures after the mite had appeared or to kill the mite without killing the Bruchid proved unsuccessful, and it was necessary to maintain all cultures and used containers at a temperature of 60°C. [140°F.] for a day to eliminate the infestation.

COLMAN (W.). **Minimum Size of Openings through which Clothes Moth Larvae can pass.**—*J. econ. Ent.* **33** no. 3 p. 582. Menasha, Wis., 1940.

Woollen materials sometimes become infested with clothes moths while they are in containers into which the adult moths are unable to penetrate, probably because eggs are laid in crevices that are large enough to allow the newly hatched larvae to enter. Tests were, therefore, made to determine the exact size of the crevice through which a newly hatched larva of *Tineola biselliella*, Humm., can pass. Large numbers of glass cells containing uninfested wool, with crevices ranging from 0·002 to 0·01 inch in width, were kept in a place containing many moths for 30 days, at the end of which time all cells with crevices of 0·004 inch or more contained larvae, whereas those with smaller crevices were uninfested.

ESSIG (E. O.). **The Golden Codling Moth ; a second Note.**—*J. econ. Ent.* **33** no. 3 p. 582. Menasha, Wis., 1940.

As a result of his note on the light-coloured form (var. *simpsoni*, Busck) of *Cydia* (*Carpocapsa*) *pomonella*, L. [*R.A.E.*, A **28** 486], the author received a letter dated 20th February 1940 from R. T. M. Pescott, stating that this form represented 2–3 per cent. of the total numbers of *C. pomonella* caught in bait traps in the small apple-growing area of the north-eastern district of Victoria (Australia) in the season 1937–38 [*cf.* also **29** 144]. *C. pomonella* has one generation a year in this area, which is at an altitude of 2,500 ft. and has an annual rainfall of about 50–60 ins.

YOTHERS (M. A.). **Effect of Lime Sulfur and of Oil Sprays on Treehopper Eggs and Emergence.**—*J. econ. Ent.* **33** no. 3 p. 583, 2 refs. Menasha, Wis., 1940.

Observations made to determine why lime-sulphur sprays (3–4°Bé) killed only about half as many eggs of the Membracid, *Stictocephala inermis*, F., on fruit trees in the North-west of the United States as did oil-emulsion sprays containing 3–4 per cent. oil [*cf. R.A.E.*, A **22** 349] showed that the oil may saturate the eggs, which then become shrivelled and discoloured and die ; it may saturate only the outer tips and a small portion of the chorion, in which case the embryos appear to be normal but few are able to break through the hardened tip ; or it may scorch the outer tip only, so that hatching begins fairly normally, but is retarded by the toughened chorion and not completed. Lime-sulphur does not seem to penetrate the eggs sufficiently to kill very many of them, nor does it appear to scorch the tips so much as the oil, but it causes the bark round the egg slits to harden, so that its sharp edges retard or prevent the emergence of many of the young nymphs from the egg slits and they soon die.

Knowlton (G. F.) & Harmston (F. C.). **Food Habits of Sparrow Hawks in Utah.**—*J. econ. Ent.* **33** no. 3 p. 583. Menasha, Wis., 1940.

During recent years, large numbers of sparrow hawks (*Falco sparvarius*) have been observed on or around farms in many rural areas in Utah. The contents of 81 stomachs taken from specimens collected since 1935 were examined. Orthoptera were present in all these, and 79 of them contained a total of 1,345 grasshoppers, of which *Melanoplus* spp. were the most abundant. Coleoptera, which included at least 9 different families, were next in importance, 48 of the stomachs containing beetles or their recognisable remains, while Lepidopterous and Dipterous larvae and Pentatomids and Odonata were present in small numbers. It is concluded that the sparrow hawk is preponderantly beneficial in its food-habits.

Wolcott (G. N.) & Martorell (L. F.). **Leafhopper Reaction to Lawn Sprinkling.**—*J. econ. Ent.* **33** no. 3 p. 584, 1 ref. Menasha, Wis., 1940.

A severe but extremely localised outbreak of *Kolla fasciata*, Wlk., occurred in Porto Rico during dry weather in January–February 1940 in restricted areas on a lawn of *Stenotaphrum secundatum*. These areas had been watered by an underground sprinkler system and so provided an exceptionally favourable environment for the Jassid, which killed the grass in them.

Pepper (B. B.) & Barber (G. W.). **Dichloroethyl Ether in Mineral Oil for Corn Earworm Control in Sweet Corn.**—*J. econ. Ent.* **33** no. 3. pp. 584–585. Menasha, Wis., 1940.

Mineral oil is more effective in protecting the ears of sweet maize from infestation by larvae of *Heliothis armigera*, Hb. [*cf. R.A.E.*, A **28** 520] if they have long tight husks than if they have short loose ones, and since most of the varieties now grown in the United States have husks that are neither long nor tight enough for effective control by the use of oil alone, a search was made for materials the addition of which would increase the effectiveness of the oil. It was found in March 1939 that pyrethrum extract would serve this purpose but was too expensive, and further investigations in the summer of 1939 showed that oil containing dichloroethyl ether gave better control at a much lower cost than oil containing pyrethrins. Mineral oil containing more than 3 per cent. dichloroethyl ether scorched or rotted the silks and husks, but oil containing less than 3 per cent. did not injure the ears and was practically as effective. The mixture can be applied with an oiler [*loc. cit.*] or by atomisation [*cf.* **26** 745]; oils with viscosities of from 125–135 to 200–210 secs. Saybolt gave the best results when applied at the rate of 0·7–1 cc. per ear. If the mixture is used when the silks have begun to turn brown or within about a week after silk exposure has begun, it kills the larvae in the ears and appears to repel others that seek to enter them.

No flavour or odour due to residues of dichloroethyl ether was detected either before or after cooking maize ears treated before mid-September, but after the latter date a residue was detected in some cooked ears. It is believed that this was due to slower evaporation

of the dichloroethyl ether after mid-September, when the temperatures were lower, but in the absence of definite evidence on this point the treatment is not at present recommended.

FULTON (B. B.). **The Hornworm Parasite,** *Apanteles congregatus* **Say and the Hyperparasite,** *Hypopteromalus tabacum* **(Fitch).**—*Ann. ent. Soc. Amer.* **33** no. 2 pp. 231–244, 3 pls., 4 refs. Columbus, Ohio, 1940.

Apanteles congregatus, Say, is the most important natural enemy of the Sphingids, *Ceratomia catalpae*, Boisd., on *Catalpa* and *Protoparce sexta*, Joh., on tobacco and tomato in North Carolina, and an account is given of studies on its bionomics as a parasite of *P. sexta* [*cf. R.A.E.*, A **27** 253] there during 1936–38. Larvae of *P. sexta* increase rapidly in numbers in late summer in fields where the tobacco stalks are left standing after harvest, and eggs have occurred as late as 1st October. In 1936, the percentage of larvae bearing cocoons of *A. congregatus* increased from 0 to 34·3 between 11th August and 28th September, and in 1937 from 1·9 to 82·2 between 26th August and 7th October, after which the larvae were killed by frost; of a total of 149 larvae collected in a tobacco field on 25th August 1938, 32·8 per cent. bore cocoons. The actual percentage parasitism is probably greater, since when nearly 50 per cent. of the larvae bear cocoons, most of the others contain parasite larvae; parasitised larvae remain longer on the food-plant, however.

The egg and three larval instars of *A. congregatus* are briefly described. The process of oviposition occupies only a few seconds; a larva that was exposed to attack for that time by each of six females contained 122 eggs, and one female deposited 28 eggs during a single act of oviposition. In the field, most eggs appear to be deposited in host larvae in the first or second instar, but a few were found in third-instar larvae; most of the fourth- and a few of the fifth-instar host larvae contained first-instar parasite larvae, but fully grown parasite larvae frequently emerged from host larvae that were in the fourth instar. The larvae of *Apanteles* emerges from its host at the end of the second instar and spins its cocoon immediately after a second ecdysis. The number of larvae that developed in a single host varied from a few to over 300, and in general they emerged from it simultaneously, although there were usually some that died within the host. The life-cycle was studied at a temperature of 29–30°C. [84·2–86°F.], but the observations had to be completed on larvae that had been parasitised in the field, as those in which eggs had been laid in the laboratory died before the parasites had completed development in them. It appeared, however, that the egg stage lasted less than 3 days, the first instar about 5 days, and the second instar less than 7. At room temperature in September, adults emerged 6–7 days after the construction of the cocoon. When the cocoons were formed shortly before or after 1st October, the larvae did not pupate until the following spring. Adults emerged on 5th April from a batch of cocoons that were maintained in a screened insectary. In the field, the cocoons remain on the host for a time, but eventually fall to the ground or become lodged in the leaf axils. Adults survived in the laboratory for only a few days, even when provided with sugar solution. Males comprised 8–50 per cent. of the number of adults in different batches,

and 37 per cent. of the total number of adults. One batch of 58 consisted exclusively of males and was probably produced by a single unfertilised female.

The most important parasites of *A. congregatus* in North Carolina are *Horismenus floridanus*, Ashm., when the host is *C. catalpae* and *Hypopteromalus tabacum*, Fitch, when it is *P. sexta*. *H. tabacum*, all stages of which are briefly described, is abundant in autumn, and adults are present after those of *Apanteles* have disappeared. The degree of parasitism increases until cold weather prevents further reproduction. Females oviposit on the larvae of *Apanteles* in their cocoons, sometimes before the latter are completed, and were frequently observed doing so in October; they feed on the body fluid of *Apanteles*, and this process and that of oviposition are described. More than one egg may be deposited on a single host but only one adult matures. When cocoons containing eggs of *H. tabacum* were kept at 30°C., some of the eggs hatched by the next day. The larvae, which feed externally on their hosts, were fully fed, but not in the prepupal stage, 3 days after hatching, and most of them had pupated by the next day, although some were still in the prepupal stage, which lasts less than a day. The pupal period occupied 4–6 days, and the total developmental period 9–10. Emergence ceases after 1st October.

Other hyperparasites reared from *A. congregatus* in 1937 were *Hemiteles* (*Acrolyta*) *mesochori*, Ashm., when the host was *Ceratomia catalpae*, and *Spilochalcis side*, Wlk., and an undescribed species of *Ceratosmicra* when it was *Protoparce sexta* on tobacco.

FLANDERS (S. E.). **Environmental Resistance to the Establishment of Parasitic Hymenoptera.**—*Ann. ent. Soc. Amer.* **33** no. 2 pp. 245–253, 27 refs. Columbus, Ohio, 1940.

The author cites instances from the literature and from his own observations demonstrating that the establishment of introduced parasitic Hymenoptera may be prevented by environmental factors that affect the activity of the ovipositing females or the development of their progeny. A parasite may fail to become established because it does not frequent host habitats or because it frequents habitats that lack hosts. The use of insecticides may reduce the host density below that required for the maintenance of the parasite population. Establishment may fail if the deposition of fertilised eggs by colonised adult parasites is inhibited by a change in condition of the host, the presence of predators or lack of food; or if the development of the parasite progeny is inhibited by the unsuitability of its normal host or by the competition of other parasites, either primary or secondary.

With regard to the effects of the condition of the host, he states that individuals of a population of black scale [*Saissetia oleae*, Bern.], which is a relatively inert host, may exhibit a comparatively wide variation in the character of the attributes causing them to be preferred by the female parasite; and since Hymenopterous parasites tend to deposit fertilised (female) eggs only on preferred individuals of a host species [*R.A.E.*, A **27** 596], factors, such as a cover of dust, small size or age, causing the host to become unpreferred and consequently to receive only unfertilised (male) eggs, decrease the possibility of establishment. *Ephialtes* (*Calliephialtes*) sp. deposits only unfertilised eggs in the cocoons of non-overwintering larvae of the codling moth

[*Cydia pomonella*, L.], which may explain the failure of an attempt to establish it in California 25 years ago. *Habrolepis rouxi*, Comp., generally completes its development in red scale [*Aonidiella aurantii*, Mask.] on *Citrus*, but rarely when the food-plant of the host is *Cycas revoluta*. *S. oleae* infesting *Citrus* in the field is highly parasitised by *Coccophagus rusti*, Comp., when on rapidly growing wood (suckers), and this is probably the effect of low mortality of the developing parasite.

Townes jr. (H. K.). **A Revision of the Pimplini of Eastern North America (Hymenoptera, Ichneumonidae).**—*Ann. ent. Soc. Amer.* **33** no. 2 pp. 283–323, 10 figs., 15 refs. Columbus, Ohio, 1940.

The Pimplini of this revision comprise the tribes Theroniini and Ephialtini of Cushman [*R.A.E.*, A **8** 509; **9** 169]; the author uses the name *Pimpla* in the traditional sense in view of the proposed retention of *Pimpla* and *Ephialtes* as *nomina conservanda* with *Ichneumon instigator*, F., and *I. manifestator*, L., as their respective genotypes. He considers, however, that *Apechthis* and *Itoplectis* (*Nesopimpla*) are generically distinct from it. One of the new species described is *P. inflata*; it is widely distributed in the United States, where its hosts include *Cydia* (*Laspeyresia*) *molesta*, Busck, and *C.* (*L.*) *pomonella*, L., and has also been taken in Quebec. The author considers that most North American records of *Pimpla* (*sens. strict.*) from *C. pomonella* refer to this species, although *C. pomonella* and *C. molesta* are both also parasitised by *P. aequalis*, Prov., in the United States.

Bushnell (R. J.) & Boughton (D. C.). **Longevity and Egg Production in the Common Bean Weevil, *Acanthoscelides obtectus* (Say).**—*Ann. ent. Soc. Amer.* **33** no. 2 pp. 361–370, 3 figs., 6 refs. Columbus, Ohio, 1940.

An account is given of a study on the relation between reproductive activity and longevity in mated and unmated adults of *Bruchus* (*Acanthoscelides*) *obtectus*, Say, using stock that had been maintained on white navy beans under laboratory conditions for four years. The adults were kept singly or in pairs in salve boxes, each containing three beans under which the females deposited their eggs but on which they did not feed, at a temperature of approximately 27°C. [80·6°F.] and a relative humidity that probably never exceeded 50 per cent. The average longevities in days were 16·6 and 16·8 for mated males and females, 17·3 for both sexes kept singly and 17·8 for unmated males kept two in a box, only the difference between the first and last group of males being significant. Mating had a pronounced effect on both the total egg production and the stimulus to early oviposition, which was delayed for an average of 3·4 days in unmated females. Mated females laid an average of 44·2 eggs or 1·56 times as many as unmated ones, and the eggs laid by the latter collapsed soon after being deposited. The average preoviposition and oviposition periods of mated females were 1·6 and 9·4 days, and all of them had completed oviposition after 16 days. There was no correlation between the total number of eggs produced and the duration of adult life in mated females, but there was a small positive correlation in unmated females. A good positive correlation existed between the length of the oviposition period and the

total number of eggs produced, and also between the length of the oviposition period and the total duration of life, for both mated and unmated females. There was a negative correlation between longevity and the average number of eggs produced per day during the oviposition period.

These results are discussed with reference to those obtained by other workers with *Trichogramma evanescens*, Westw. [*R.A.E.*, A **26** 545] and *Drosophila melanogaster*, Mg.

WOLFENBARGER (D. O.). **Relative Prevalence of Potato Flea Beetle Injuries in Fields adjoining Uncultivated Areas.**—*Ann. ent. Soc. Amer.* **33** no. 2 pp. 391–394, 1 fig., 1 ref. Columbus, Ohio, 1940.

Observations on the relative prevalence of injury by larvae of *Epitrix cucumeris*, Harr., to potatoes in fields adjoining cultivated and uncultivated areas were made in western New York State in 1931, 1932 and 1933. In a field measuring 10–12 acres and bordered at the western end by trees and underbrush and on the other three sides by cultivated land, the highest percentage (18) of injured tubers occurred near the uncultivated area ; the percentage decreased until a distance of 100–200 ft. was reached, after which it became more nearly constant as the distance into the field increased, being 5 at 400 ft. and 6 at both 200 and 500 ft. In another field, bordered on the west and south by a heavy undergrowth of small trees, shrubs and other plants, among which *Solanum dulcamara* was especially abundant, there were more injuries in the west and south sections than in the north and east, which adjoined cultivated land. Further investigations showed that the adults hibernated both in uncultivated, and, to a less extent, in cultivated soil ; the average number that emerged from samples of soil taken in early May from various types of uncultivated land near a potato field was 1·08, whereas that from similar samples taken from various points in the potato field was 0·95, and the difference is significant. The number of hibernating adults per acre of uncultivated and cultivated soil was estimated as over 188,000 and over 22,000, respectively.

Dense shade and the absence of *S. dulcamara*, which does not grow well in shade, appear, separately or in combination, to provide a habitat that is unfavourable for *E. cucumeris* ; there were fewer injured tubers in fields where such conditions prevailed, and adults were less numerous in dense shade. Aspect and prevailing winds did not influence the distribution of injury, which occurred to varying degrees throughout each field. No points at which no injured tubers occurred were observed at any distance of practical significance from uncultivated land, but plants at a distance of at least 100 ft. from favourable border vegetation receive a substantial degree of protection. Since the feeding period of the adults is longer than the growing period of the potato, some beetles hibernate when this food-plant dies and others migrate to less favoured plants in uncultivated areas, where they feed and breed, thus providing a source of re-infestation.

MACKIE (D. B.) & others. **Bureau of Entomology and Plant Quarantine.** —*Bull. Dep. Agric. Calif.* **28** (1939) no. 10 pp. 530–566. Sacramento, Calif., 1940.

Notes are given on work in California in 1939 in connection with the campaigns for the eradication of *Dialeurodes citri*, Ril. & How., and

Chrysomphalus obscurus, Comst. [*cf. R.A.E.*, A **28** 63, etc.]. Operations against the latter involved pecan trees on three properties, but prospects of success with sprays are remote, as the bark plates afford protection to it and oil sprays at effective concentrations are likely to injure pecan. It is thought advisable to destroy the trees, in view of the potential importance of the Coccid as a pest of walnut. Some of the trees originally infested by *Lepidosaphes halli*, Green, which was supposed to have been eradicated [**26** 747], were found to be re-infested and were destroyed. The area infested by *Parlatoria oleae*, Colv. [*cf.* **28** 63] was found to cover approximately 410,000 acres, and in the county believed to contain the original focus, 159 plants of nearly 100 genera were attacked. Inspection led to the discovery of 24 foci of infestation by *Aonidiella aurantii*, Mask., on unstated plants in an area of 30 sq. miles in Ventura County; it has not yet been recorded on *Citrus* in this county, and its eradication there is therefore being attempted. *Hypera variabilis*, Hbst., was found on lucerne at one point outside the quarantine area in the San Joaquin Valley and also in northern California.

Owing to lack of spring rains, little or no fruit was set on *Prunus emarginata*, but the species of *Rhagoletis* that infests it [**28** 63] did not attack cultivated cherries growing in the immediate vicinity. Cultivated sweet cherries, however, ripen and drop or are harvested about 3 weeks before the adults appear. Early and late strains of *P. emarginata* occur, often in the same district, and in one area one ripens early enough to be attractive before the other has set fruit. Adults of *Rhagoletis* were observed on *P. demissa*, but extensive surveys indicated that it was not attacked. A legislative problem is raised by the presence of this fly, since it cannot be distinguished, except by biological differences, from *R. cingulata*, Lw. [*cf.* **25** 471], which attacks cultivated cherries in Oregon and Washington and against which a quarantine is in force.

In view of the satisfactory results obtained by fumigating pears infested by codling moth [*Cydia pomonella*, L.] with methyl bromide at the rate of 2 lb. per 1,000 cu. ft. for 2 hours at temperatures above 70°F. [**29** 113], the same dosage and schedule, with certain modifications to meet different temperatures, was successfully applied to potato tubers infested with tuber moth [*Gnorimoschema operculella*, Zell.]. Grain infested by insects can be fumigated with methyl bromide at the rate of 1 lb. per 1,000 cu. ft. grain for 24 hours; in test cases, upright bins containing 14,000 cu. ft. were treated in this manner. Filled wine casks attacked by *Scobicia declivis*, Lec., which bores into them and causes them to leak, were successfully treated by vacuum fumigation.

A serious outbreak of grasshoppers occurred during the year, and surveys were carried out to determine the size of the adult populations and the extent of the oviposition areas of the principal species [*cf.* **28** 188]. *Melanoplus devastator*, Scudd., was the most widely distributed; it was most abundant in the San Joaquin and Sacramento Valleys, and the greatest concentrations occurred in the foothill range lands and in grassland adjoining cultivated crops. Oviposition begins after the first autumn rains and continues until mid-January, but was delayed in 1939 owing to prolonged dry autumn weather. As a result, the adult population is likely to be reduced, but that of *Oedaleonotus enigma*, Scudd., which was distributed over approximately the same area but oviposits in summer and autumn, is unlikely to be

affected. *M. mexicanus*, Sauss., was dominant in Riverside and Mono counties; oviposition was practically confined to cultivated fields, particularly those planted with lucerne, and ditch-banks and other well-drained sites were preferred. *Camnula pellucida*, Scudd., occurred in the higher range lands. *M. femur-rubrum*, DeG., *M. differentialis*, Thos., and *M. bivittatus*, Say, were late in appearing and local in distribution. The field cricket, *Gryllulus* (*Gryllus*) *assimilis*, F., was more abundant than usual. *Anabrus simplex*, Hald., occurred over a very small area but caused no loss; surveys in September established that the egg-pods were dug up by skunks and white-footed mice [*Peromyscus*].

Colias (*Eurymus*) *eurytheme*, Boisd., damaged lucerne throughout the area in which it is grown and caused losses as great as one ton per acre in one county. *Hercothrips fasciatus*, Perg., on beans was, for the sixth year in succession, controlled by eradicating prickly lettuce [*Lactuca scariola*] in spring. *Taeniothrips inconsequens*, Uzel, caused some damage to pears in Sacramento Valley and certain mountain counties. A spray containing 5 per cent. lime-sulphur and 3 per cent. winter oil was fairly effective against Baker's mealybug [*Pseudococcus maritimus*, Ehrh.] when applied to dormant pear trees that were not too dry. There is some evidence that the insecticidal properties of lime-sulphur are overlooked where fungicides rendering its use unnecessary are employed on fruit trees, and in such cases populations of *Aspidiotus* (*Quadraspidiotus*) *perniciosus*, Comst., appear to have been built up as a result. *Spilonota ocellana*, Schiff., which is recorded from California for the first time, attracted considerable attention on plums and prunes in San José. The broad mite [*Tarsonemus latus*, Banks] was found to be established on peppers [*Capsicum*] in Los Angeles county in October [see next abstract] and has since been recorded on English ivy and a weed. The filbert big-bud mite [*Eriophyes avellanae*, Nal.] was recorded on filberts [*Corylus*] in Butte county, where it was well established.

The area over which insecticides were applied by aeroplane was more than 3 times as large as in 1938, chiefly owing to the use of this method for distributing 400 tons of moist bran bait to control grasshoppers. An areoplane flying 50 ft. above the ground could apply bait to 200 acres or more in an hour. The cost of application compared favourably with that of other methods of broadcasting, and the speed with which applications can be made is advantageous, since grasshoppers feed most freely within a narrow range of temperature (65–80°F.). The area under each crop that was treated by aeroplane during the year is given in a table. Notes on revisions of quarantine regulations against a number of insect pests and lists of injurious insects intercepted at maritime and air ports, at border inspection stations, and within the State are also included.

Hewitt (J. L.). **Bureau of Nursery Service.**—*Bull. Dep. Agric. Calif.* **28** (1939) no. 10 pp. 590–592. Sacramento, Calif., 1940.

A list of Coccids found on nursery stock in California during 1939 includes two species probably recorded for the first time in the State, *viz.*, *Chionaspis furfura*, Fitch, which was heavily parasitised, on *Cotoneaster*, and *Lepidosaphes camelliae*, Hoke, on *Camellia*. *Aspidiotus lataniae*, Sign., which destroyed fuchsias and heavily infested *Camellia* in coastal

districts, to which it was at one time thought to be confined, was also found in warm inland valleys. *Tarsonemus* (*Hemitarsonemus*) *latus*, Banks, severely injured ornamental peppers [*Capsicum*] under glass [see preceding abstract], but was brought under control by means of liberal applications of sulphur dust.

Beaulieu (A. A.). **Studies on the Life History of the Codling Moth in southwestern Quebec.**—*Sci. Agric.* **20** no. 11 pp. 624–631, 2 graphs, 1 ref. Ottawa, 1940.

In 1939, investigations on the seasonal history of the codling moth [*Cydia pomonella*, L.] on apple in south-western Quebec were continued on the same lines as in the two preceding years [*R.A.E.*, A **28** 422]. The tables already noticed [*loc. cit.*] are reproduced and expanded to include the results obtained in 1939. It is concluded that there was a gradual decrease in the size of the partial second generation from 1937 to 1939, which is in close relationship with a similar decrease of the mean daily temperature over these years.

Papers noticed by Title only.

Flint (W. P.) & Anderson (H. W.). **Directions for spraying Fruits in Illinois.**—*Circ. Ill. agric. Exp. Sta.* no. 492, 32 pp., 6 figs. Urbana, Ill., 1940. [*Cf. R.A.E.*, A **28** 19.]

Tuck (J. B.) & Smith (R. C.). **Identification of the Eggs of Mid-western Grasshoppers by the Chorionic Sculpturing.**—*Tech. Bull. Kans. agric. Exp. Sta.* no. 48, 39 pp., 11 pls., 7 refs. Topeka, Kans., 1940.

Ludwig (D.) & Abercrombie (W. F.). **The Growth of the Head Capsule of the Japanese Beetle Larva** [*Popillia japonica*, Newm., permitting determination of the instars].—*Ann. ent. Soc. Amer.* **33** no. 2 pp. 385–390, 2 figs., 9 refs. Columbus, Ohio, 1940.

Pielou (D. P.) & Gunn (D. L.). **The Humidity Behaviour of the Mealworm Beetle,** *Tenebrio molitor* **L. I. The Reaction to Differences of Humidity.**—*J. exp. Biol.* **17** no. 3 pp. 286–294, 4 figs., 14 refs. London, 1940.

Pielou (D. P.). **The Humidity Behaviour of the Mealworm Beetle,** *Tenebrio molitor* **L. II. The Humidity Receptors.**—*J. exp. Biol.* **17** no. 3 pp. 295–306, 7 figs., 16 refs. London, 1940.

Morofsky (W. F.). **A comparative Study of the Insect Food of Trout** [analyses of the stomach contents in Michigan].—*J. econ. Ent.* **33** no. 3 pp. 544–546. Menasha, Wis., 1940. [*Cf. R.A.E.*, A **23** 314; **25** 32.]

Williams (C. B.). **The Numbers of Insects caught in a Light Trap at Rothamsted during four Years 1933–1937.**—*Proc. R. ent. Soc. Lond.* (A) **15** pt. 7–9 pp. 78–80, 12 refs. London, 1940. [*Cf. R.A.E.*, A **29** 152.]

Paillot (A.). **Existence d'une septicémie à spirochètes** [*Spirochaeta pieridis*, sp. n.] **chez les chenilles de** *Pieris brassicae* [in France]. —*C. R. Acad. Sci.* **210** no. 17 pp. 615–616. Paris, 1940.

REVISTA DE ENTOMOLOGIA

An International Review of Entomology

An illustrated magazine published four times a year by **THOMAZ BORGMEIER, O.F.M.,** devoted to entomology, mainly of the neotropical fauna.

The volumes already published since 1931 comprise thousands of pages and contain articles by leading entomologists such as F. W. Edwards, W. Horn, E. Lindner, J. W. S. Macfie, E. Martini, A. da Costa Lima, F. Silvestri, C. Menozzi, A. Reichensperger, F. Santschi, J. D. Hood, etc., with a bibliography of the current literature (economic and non-economic) of the neotropical fauna.

Annual subscription $4.00 U.S. ($5.00 U.S. through booksellers). All payments are in advance. The back volumes are still on sale; price of each volume 4 U.S. dollars; through booksellers 5 U.S. dollars.

Subscriptions should be sent to the Editor: Thomaz Borgmeier, O.F.M., Convento S. Antonio, Largo da Carioca, Rio de Janeiro, Brazil.

IMPERIAL INSTITUTE OF ENTOMOLOGY.

LIBRARY LACUNAE.

The Institute will be greatly indebted to readers who may be able to supply any of the following, which should be sent to the Assistant Director, Imperial Institute of Entomology, 41, Queen's Gate, London, S.W.7.

AGRICULTURAL JOURNAL, DEPARTMENT OF AGRICULTURE, BRITISH COLUMBIA (VICTORIA): Vol. I (1916), Nos. 1 and 2.

AGRICULTURAL NEWS (BARBADOS): Nos. 1, 25, 26, 34, 66 (1902–04).

ANNALS OF THE QUEENSLAND MUSEUM (BRISBANE): Nos. 1, 5 and 6 (1891–).

ANNUAIRE ET MÉMOIRES DU COMITÉ D'ETUDES HISTORIQUES ET SCIENTIFIQUES DE L'AFRIQUE OCCIDENTALE FRANÇAISE (GORÉE): Vols. I–II (1916–17).

ARCHIVES DE L'INSTITUT PASTEUR DE TUNIS:
1906–09; 1910, fasc. i–iii; 1911, fasc. iii–iv.

ARCHIV FÜR SCHIFFS- UND TROPEN-HYGIENE (LEIPZIG):
Bd. XVII (1913). Heft 9.

ARQUIVOS DO INSTITUTO BACTERIOLOGICO CAMARA PESTANA (LISBON):
Vols. I–II (1906–10). Vol. III No. 1 (1911).

THE BEE WORLD (BENSON, OXON): Vols. I–II (1919–21).

BIOLOGICAL BULLETIN OF THE MARINE BIOLOGICAL LABORATORY (WOODS HOLE, Mass.):
Vols. I–II (1899–1901); XXIII (1912); XXIV (1912) No. 2; XXV (1913) Nos. 5–6; XXVI (1914) Nos. 1–2; XXVII (1914) No. 4; XXVIII (1915) No. 1; XXIX (1915) No. 5; XXX (1916) Nos. 2–3; XXXI (1916) Nos. 4 & 6; XXXII–XXXIII (1917); XXXIV (1918) Nos. 1–4, & 6; XXXV (1918); XXXVI (1919) Nos. 2–3; XXXVII (1919) Nos. 4 & 6; XXXVIII (1920) Nos. 1, 2, 5 & 6; XXXIX (1920) Nos. 4–6; XL (1921) Nos. 1–4, & 6; XLI (1921) Nos. 2 & 3; XLII (1922) Nos. 1–3.

BOLETIN DE LA DIRECCION DE ESTUDIOS BIOLOGICAS (MEXICO):
Tomos I–II (1924–25).

LIBRARY LACUNAE.—*cont.*

BULLETIN AGRICOLE DE L'ALGÉRIE—TUNISIE—MAROC (ALGIERS) :
Année XX (1914). Nos. 7–9, 12–14 and Title-page.
BULLETIN DU COMITÉ D'ETUDES HISTORIQUES ET SCIENTIFIQUES DE L'AFRIQUE OCCIDENTALE FRANÇAISE (PARIS) : Année 1919, No. 1.
CALIFORNIA AGRICULTURAL EXPERIMENT STATION (BERKELEY, CAL.) :
Circulars 14 and 42 (1905–09).
CHACARAS E QUINTAES (SÃO PAULO) : Indices to Vols. X, XI, XII, XIV and XLII, No. 3.
COMPTES RENDUS DES SÉANCES DE L'ACADÉMIE D'AGRICULTURE DE FRANCE (PARIS) : Tome VIII (1922) No. 5.
EGATEA, REVISTA DA ESCOLA DE ENGENHARIA DE PORTO ALEGRE, BRAZIL :
Vols. I–VI (1916–21) ; VII (1922) Nos. 1–5 ; VIII (1923) Nos. 2–5 ; IX (1924) Nos. 1, 4–6.
ENTOMOLOGICA AMERICANA (BROOKLYN, N.Y.) :
Vol. IV (1888) Title-page. Vol. V (1889), Nos. 6 & 8.
ENTOMOLOGISCHE LITTERATURBLÄTTER (BERLIN) : 6. Jahrg. (1906). Nos. 2 & 10.
EXPERIMENT STATION RECORD (WASHINGTON, D.C.) : Vols. I–IV (1889–94).
GEORGIA STATE BOARD OF ENTOMOLOGY (ATLANTA) :
Bulletin : 2, 6, 22 and 28. Circular : 1 to 3, 12, 15 to 18 and 20.
INDIA : FOREST RESEARCH INSTITUTE (DEHRA DUN) :
Forest Bulletin (Old Series) : Nos. 1–3.
INDIAN MEDICAL GAZETTE (CALCUTTA):
Vol. L (1915) No. 10 : LI (1916) Nos. 1–7, 10 ; LII (1917) No. 7 and title-page & index ; LIII (1918) ; and LIV (1919) No. 2.
INDIANA : Third Annual Report of the State Entomologist, 1909–10.
JOURNAL OF THE BOARD OF AGRICULTURE OF BRITISH GUIANA (DEMERARA) Vol. III No. 1 (1909). Title pp. and Indices to Vols. I–II.
JOURNAL OF THE SOUTH-EASTERN AGRICULTURAL COLLEGE (WYE, KENT) : Nos. 1–6, 8, 11–13 (1895–1904).
KENTUCKY AGRICULTURAL EXPERIMENT STATION (LEXINGTON, Ky.) :
Bulletin Nos. 21 (1889), 31 (1890), 47 (1893), 53 (1894), 74 (1898) and 91 (1901).
THE KENYA AND EAST AFRICAN MEDICAL JOURNAL (NAIROBI) : Vol. II Nos. 2–3 (1925).
NATUURHISTORISCH MAANDBLAD (MAASTRICHT) : Jaarg. I (1912) ; II (1913) Nos. 1–4, 6–9 ; V (1916) Nos. 3–4 ; VII (1918) Nos. 6–9 ; VIII (1919) No. 4.
NEW JERSEY STATE DEPARTMENT OF AGRICULTURE (TRENTON, N.J.) : Bulletin 2 ; Circular : 2, 12, 29 (1917–19).
NEW YORK STATE MUSEUM (ALBANY, N.Y.) : Bulletin : 26 & 57 (1899–1902).
ONTARIO ENTOMOLOGICAL SOCIETY REPORT (TORONTO) : 9th (1878).
ORMEROD (E. A.). OBSERVATIONS OF INJURIOUS INSECTS AND COMMON FARM PESTS DURING THE YEARS 1877 & 1878 (London, 1878–79).
PHILIPPINE AGRICULTURIST AND FORESTER (MANILA) :
Vols. II Nos. 1-3 (1912) ; III Nos. 1, 2 (1914) ; IV No. 4 (1915).
PHILIPPINE JOURNAL OF SCIENCE (MANILA) : Vol I (1906) No. 10.
PORTO RICO DEPARTMENT OF AGRICULTURE, &c. (SAN JUAN) :
Journal, Vol. I (1917) No. 3.
PSYCHE (BOSTON, MASS.) : Vols. XI (1904), XIII (1906), XVI (1909).
RECORDS OF THE EGYPTIAN GOVERNMENT SCHOOL OF MEDICINE (CAIRO) : Vol. I.

NOTICES.

Secretaries of Societies and Editors of Journals willing to exchange their publications with those of the Institute are requested to communicate with the Assistant Director.

The Annual Subscription, *in advance*, to the Review, Series A (Agricultural), is 30s. post free ; Series B (Medical and Veterinary), 15s. post free. Subscriptions to the *current* Volume received after 30th June in each year will be charged at the published price *viz.*: Series A, 36s. ; Series B, 18s. Prices of Back Volumes on application.

Orders and subscriptions should be sent direct to the Assistant Director, Imperial Institute of Entomology, 41, Queen's Gate, London, S.W.7, or through a bookseller.

CONTENTS.

PAGE

AFRICA, EAST : Insect Pests in Nyasaland in 1939 153
AFRICA, EAST : Agriculture in Uganda (*Review*) 175
AFRICA, EAST : Work on Coffee Pests in Tanganyika in 1938 175
AFRICA, EAST : A Tracheal Mite infesting *Locusta migratoria migratorioides* 177
AFRICA, SOUTH : Aeroplane Dusting against invading Swarms of *Nomadacris septemfasciata* 156
AFRICA, SOUTH : *Myzus persicae* on Tobacco in S. Rhodesia 184
AFRICA, SOUTH : The Control of *Calandra oryzae* in S. Rhodesia 184
AMERICA : A Survey of Data on *Diatraea saccharalis* 160
AMERICA, NORTH : Revisions of the CHALCIDINI and PIMPLINI ... 189, 220
ARGENTINA : New Tachinid Parasites of Lepidoptera 169
AUSTRALIA : A Record of *Cydia pomonella* var. *simpsoni* in Victoria ... 216
AUSTRALIA, WESTERN : *Austroicetes cruciata* and its Egg Parasites ... 169
BRAZIL : *Pseudococcus comstocki* and a Disease of *Citrus* Roots ... 167, 168
BRITISH ISLES : The Bearing of Fungous Decay on Destruction of Wood by *Xestobium* 178
BRITISH ISLES : Meteorological Factors affecting Aphid Migration ... 180
BRITISH ISLES : The Infestation of Grain by Insects 186
CANADA : The Seasonal History of *Cydia pomonella* in Quebec 224
CEYLON : A Mermithid Parasite of *Homona coffearia* 173
CEYLON : Work on Pests of Tea in 1939 174
CHINA : The Insect Wax Industry of Szechuan 153
CHINA : *Plutella maculipennis* on Crucifers in Hong Kong 153
FIJI : Notes on Insect Pests 169
FORMOSA : Sterility of *Eucosma schistaceana* caused by natural high Temperature 172
FRANCE : A new Spirochaete in *Pieris brassicae* (*Title only*) 224
GUIANA, DUTCH : Leaf-cutting Ants and their Control 169
INDIA : A List of predacious Insects 175
INDIA : Observations on miscellaneous Insects in 1938–39 183
INDIA : Pests of Sugar-cane and their natural Enemies 184
ITALY : The Effect of the Food-plant on Sprays against *Epidiaspis leperii* 155
JAPAN : The Bionomics and Control of *Acanthocoris sordidus* 171
JAPAN : Observations on the Oviposition of *Lymantria dispar* 171
JAPAN : A Mite infesting Silkworms 172
JAPAN : The natural Enemies of *Apanteles liparidis* 172
JAPAN : Parasites of *Ceroplastes rubens* on *Citrus* 172
JAPAN : Effects of Humidity and Food on Size of *Calandra oryzae* ... 172
JAPAN : The Effect of the Food-plant on Development of *Chlorops oryzae* 173
JAPAN : Observations on *Pieris rapae* 173
JAPAN : Baits for Crickets 173
JAPAN : The Food-plants of *Prociphilus oriens* 173
KOREA : Sprays repellent to *Lachnosterna morosa* 171
NETHERLANDS INDIES : Pests of *Pithecolobium lobatum* and *Parkia speciosa* 182
RUSSIA : Investigations on Flax Flea-beetles 181
U.S.A. : The Bionomics of *Hylemyia cilicrura* in the Carolinas 158
U.S.A. : Pests and Diseases of Pecan... 159
U.S.A. : *Aegeria exitiosa* on Peach and its Control 159
U.S.A. : Nicotine-bentonite against *Cydia pomonella* in Missouri... ... 160
U.S.A. : Work on miscellaneous Pests in Connecticut in 1939 161
U.S.A. : Observations on Insect Pests in Maine in 1938–39 164
U.S.A. : *Trypodendron* spp. and their associated Fungi 165
U.S.A. : Introduction of Selenium into Plants against Aphids and Mites 165, 207
U.S.A. : A probable Reservoir of Tobacco Streak 166
U.S.A. : An Outbreak of *Datana integerrima* in Missouri 166
U.S.A. : A Nematode Parasite of *Anabrus simplex*... 187
U.S.A. : Resistance of Strains of Maize to *Aphis maidis* 187
U.S.A. : Aphids and Potato Virus Diseases in Maine 188
U.S.A. : The Bionomics of *Parornix prunivorella* on Apple, etc. 190
U.S.A. : Sprays against Aphids and Mites on Apple 191, 194
U.S.A. : The Bionomics of *Nodonota puncticollis* in Pennsylvania ... 192
U.S.A. : Biological Control of *Cydia molesta* and *C. pomonella* in Georgia 192
U.S.A. : Flight Habits of *Cydia pomonella* 193

CONTENTS—*cont.*

PAGE

U.S.A.: Technique in Control Experiments with Apple Aphids 195
U.S.A.: *Pseudococcus comstocki* on Apple and *Catalpa* in Virginia ... 195
U.S.A.: Sprays against *Rhagoletis* spp. on Cherry in New York 196
U.S.A.: The Bionomics and Control of *Conotrachelus nenuphar* on Peach 196, 197
U.S.A.: Food-plants of *Psallus seriatus* in Texas 198
U.S.A.: Soil Fumigation against *Otiorrhynchus ligustici* in New York ... 198
U.S.A.: Observations on Cabbage Caterpillars in S. Carolina 199
U.S.A.: Investigations on the Bionomics of *Epitrix parvula* ... 200, 201
U.S.A.: Calcium Cyanide against *Anasa tristis* in Arkansas 201
U.S.A.: Insecticides against *Macrosiphum onobrychis* on Peas 202
U.S.A.: Reproduction of *Macrosiphum onobrychis* on resistant and susceptible Lucerne 202
U.S.A.: Soil Fumigation against *Anomala orientalis* on Azalea 203
U.S.A.: Tests of Sprays against *Taeniothrips simplex* on *Gladiolus* ... 204
U.S.A.: Changes in Agriculture and their Effect on Insect Pests... ... 204
U.S.A.: Grasshoppers and Soil Erosion in Michigan 204
U.S.A.: Evaluation of Insect Damage under the Crop Insurance Plan ... 205
U.S.A.: The Effect of Grasshopper Poisons on Pheasants... 205
U.S.A.: Factors affecting Deposits of Insecticides on Apples 206
U.S.A.: Particle Size affecting insecticidal Action of Paris Green ... 208
U.S.A.: Methyl Bromide against Larvae of *Pantomorus* spp. 208
U.S.A.: Winter Mortality of *Saissetia oleae* on Orange in California ... 209
U.S.A.: Fumigation of sacked Grain with Chloropicrin 209
U.S.A.: The Bionomics and Importance of *Leptothrips mali* 210
U.S.A.: Factors in the natural Control of *Dendroctonus frontalis* in Virginia 211
U.S.A.: The Spread of *Scolytus multistriatus* and Dutch Elm Disease ... 212
U.S.A.: The Problem of the Spread of *Lymantria dispar* 212
U.S.A.: The Twig Girdlers of the Genus *Oncideres* 213
U.S.A.: Studies on the Bionomics of *Lachnosterna* spp. in Texas... ... 213
U.S.A.: Sprays containing Tartar Emetic against *Tetranychus telarius* ... 214
U.S.A.: Inheritance of Resistance to *Mayetiola destructor* in Wheat ... 215
U.S.A.: Destruction of Cultures of a Bruchid by *Pediculoides ventricosus* 215
U.S.A.: Effects of Lime-sulphur and Oil on Membracid Eggs 216
U.S.A.: Insect Food of Sparrow Hawks in Utah 217
U.S.A.: Dichloroethyl Ether in Oil for protecting Maize Ears from *Heliothis* 217
U.S.A.: The Bionomics of *Apanteles congregatus* 218
U.S.A.: The Relation of Uncultivated Land to *Epitrix cucumeris* on Potato 221
U.S.A.: Miscellaneous Pests in California in 1939 ... ... 221, 223
U.S.A.: Directions for spraying Fruits in Illinois (*Title only*) 224
U.S.A.: Identification of Eggs of Mid-western Grasshoppers (*Title only*) 224
U.S.A.: Insect Food of Trout (*Title only*) 224
West Indies: Resistance of different Woods to *Calotermes brevis* ... 157
West Indies: Moisture favouring *Kolla fasciata* in Porto Rico 217
Insect Pests in Moorish and Arab Literature... 157
Factors affecting the Distribution of *Pseudococcus citri* 155
Calculations of the Effect of Climatic Factors on Insect Development ... 156
The Effect of Climatic Factors on Distribution of *Loxostege sticticalis* ... 161
Isolation of *Ophiostoma ulmi* from Scolytids stored at different Temperatures 166
The Influence of Temperature, Moisture and Food on *Oryzaephilus surinamensis* 186
The Problems of Insect Study (*Review*) 189
The Orientation of Animals (*Review*)... 178
Feeding Methods of Aphids in Relation to Virus Diseases 179
A Method for Rearing Cutworms 199
Toxicity to Insects of Nicotine administered internally 206
Passage of Clothes Moth Larvae through narrow Crevices... 216
Environmental Resistance to the Establishment of Parasitic Hymenoptera 219
Longevity and Egg Production in *Bruchus obtectus* 220
Determination of Larval Instars of *Popillia japonica* (*Title only*) 224
The Humidity Behaviour of *Tenebrio molitor* (*Title only*) 224
Captures of Insects in a Light-trap (*Title only*) 224

Printed under the authority of His Majesty's Stationery Office
by the South Essex Recorders, Ltd., Ilford.

(508) Wt. P14/3703 1700 5/41 S.E.R. Ltd. Gp. 432.